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Thank you for purchasing the Curve Tracer Software (765670).

This user's manual explains the features, operating procedures, and handling precautions of the Curve Tracer Software. To ensure correct use, please read this manual thoroughly before beginning operation.

Keep this manual in a safe place for quick reference in the event that a question arises.

For an explanation of the features, operating procedures, and handling precautions of the GS610 or GS820 and of the operating procedures of Windows, see their respective manuals.

## Notes

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## Revisions

1st Edition: July 2008  
2nd Edition: January 2009

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# Notes about Using This Software

## **Storing the CD-ROM**

Keep the original CD-ROM for this software in a safe place. To use this software, install it on a PC hard disk, and run it from the PC.

## **Using the Software**

- Do not operate the GS610 or GS820 (hereinafter referred to as the GS) while using this software. Doing so may cause errors.
- The software may stop functioning when the PC is in standby mode. Disable standby mode when you use this software.
- If a connection error disrupts the connection between the GS and the PC, turn the GS off and then on again.

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# 1.1 Features

This software contains the following two curve tracer applications.

- GS610\_CurveTracer.exe for the GS610
- GS820\_CurveTracer.exe for the GS820

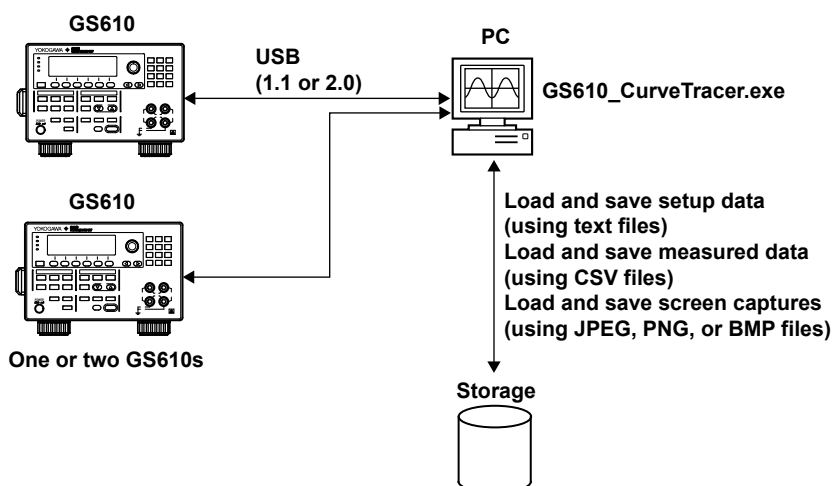
When you connect this software to the YOKOGAWA GS610 or GS820 (hereinafter referred to as the GS), you can:

- Control the GS, use it to measure electric characteristics, and display characteristic curves (mainly I-V curves).
- Save measured data to CSV files.  
Load measured data files that you have saved and use them to display waveforms.
- Save setup data to text files.  
Load setup information that you have saved.
- Save screen captures to JPEG, PNG, or BMP files.

The GS models that you can control using this software are listed below. Also, you cannot run multiple instances of the Curve Tracer Software from a single PC.

- GS610: One or two at a time
- GS820: One at a time

Using the Curve Tracer Software with the GS610

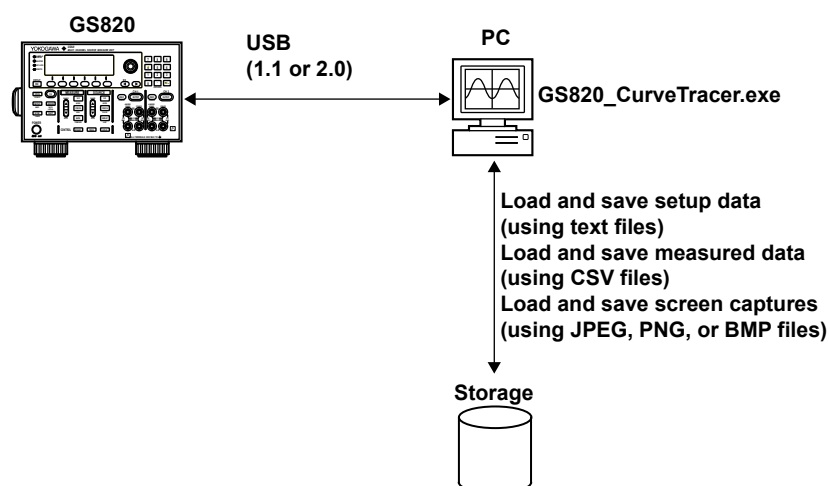


If you only connect one GS610, you cannot use the sub-channel in curve trace operations. You can only use the two circuit configurations that do not use the sub-channel (see section 5.2 for details), which are listed below.

This software can only control one GS at a time. Also, you cannot run multiple instances of the Curve Tracer Software from a single PC.



### Using the Curve Tracer Software with the GS820



### Instruments That This Software Can Control

This software can be used with the following YOKOGAWA instruments. For an explanation of the features, operating procedures, and handling precautions of the GS, see their respective manuals.

Instrument	Model
GS610	765501
GS820	765601 and 765602

## 1.2 System requirements

### PC

#### Memory

512 MB or more

#### HDD

1 GB or more of free space

### Operating System

Windows 2000 Professional (Service Pack 3 or later), Windows XP Home Edition, Windows XP Professional, or Windows Vista.

### USB Interface

One or two USB 1.1 or 2.0 ports

### USB Cable

One or two AB-type standard USB cables for connecting one or two GSs to the PC

### Display and Mouse

Must be compatible with the operating systems listed above

### GS

#### GS610 (one or two)

The standard model (765501)

Firmware version 1.04 or later

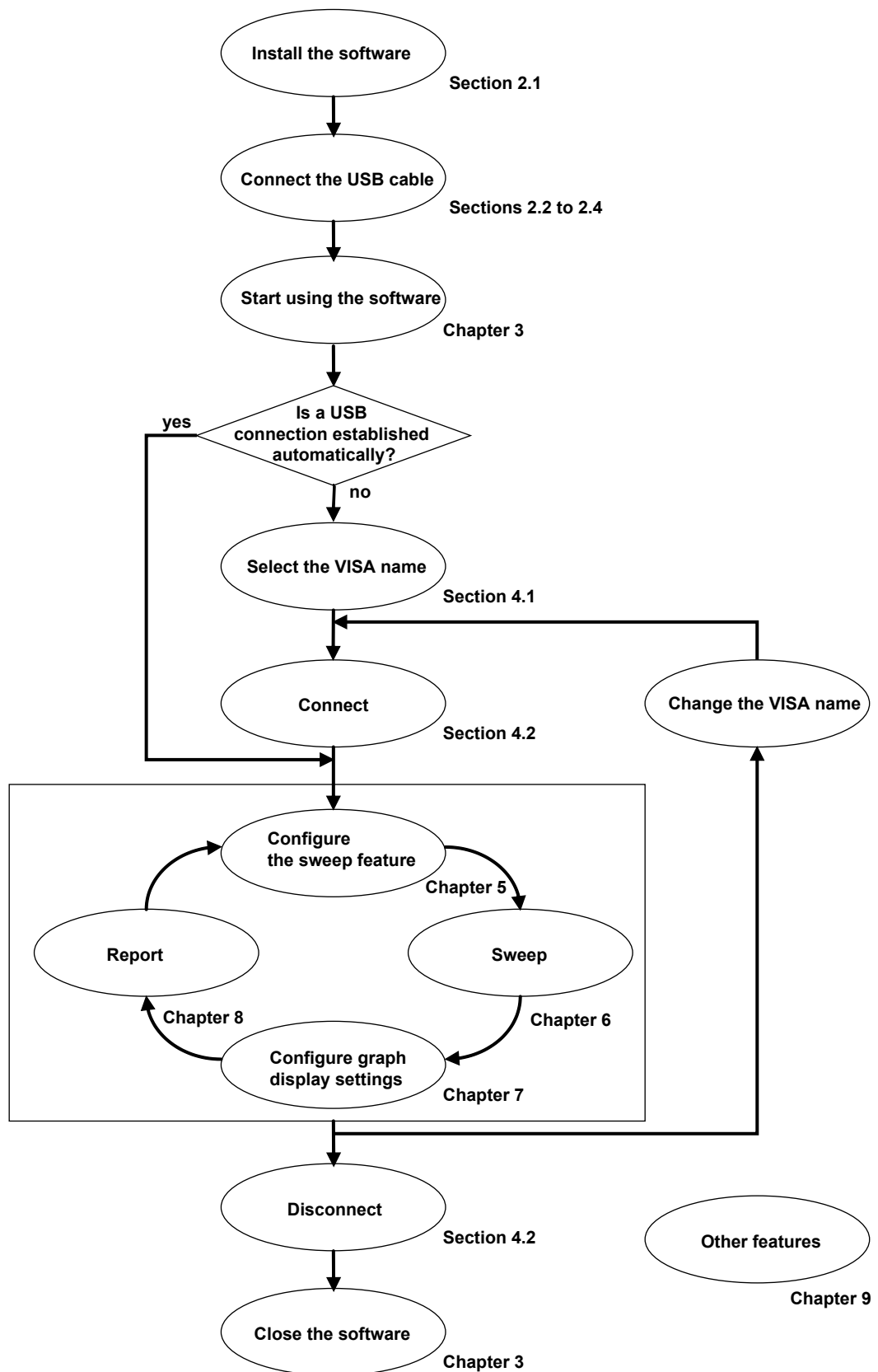
#### GS820 (one)

The standard model (765601) or the digital I/O model (765602).

The GS must meet the following requirement for this software to be able to use the auto measurement range feature.

- Firmware version 1.04 or later

## 1.3 Workflow



## 2.1 Installing and Uninstalling the Software

### Installing the Software

This section explains how to install the software on Windows XP.

When you execute the installation, the following runtime library is installed with the software.

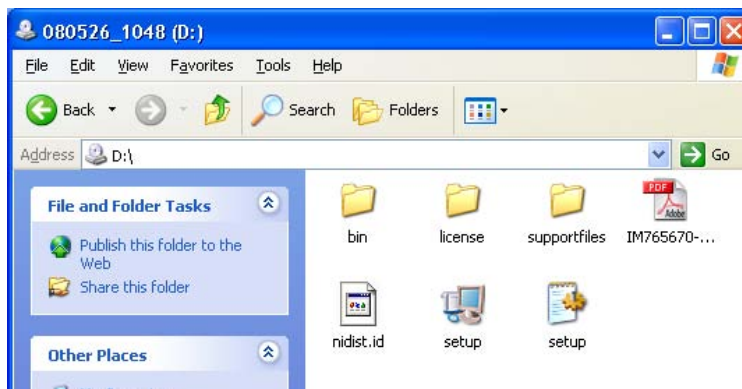
#### NI-VISA Runtime

The license for this library belongs to National Instruments. The library will not be installed if the PC that you are installing the software to already has the same version or a later version of the library installed.

### Note

If there is an older version of the Curve Tracer Software on the PC that you are installing to, the older version will be overwritten when the new version is installed. To install an older version of the Curve Tracer Software to the PC, follow the instructions on page 2-4 to uninstall the current version, and then install the older version.

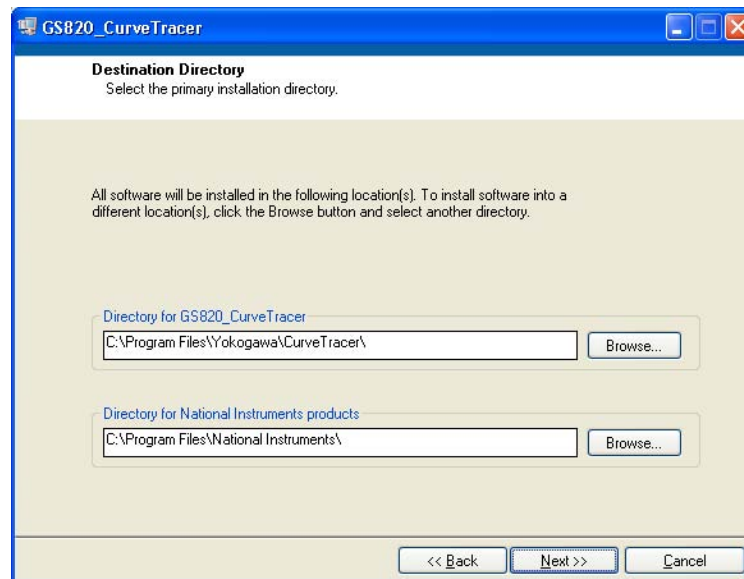
1. Turn on the PC and start up Windows. Log on as an administrator.
2. Insert the Curve Tracer Software installation disk into the CD-ROM drive.
3. Select the CD-ROM drive from the **My Computer** window.
4. Double-click **Setup.exe** to start the installer.



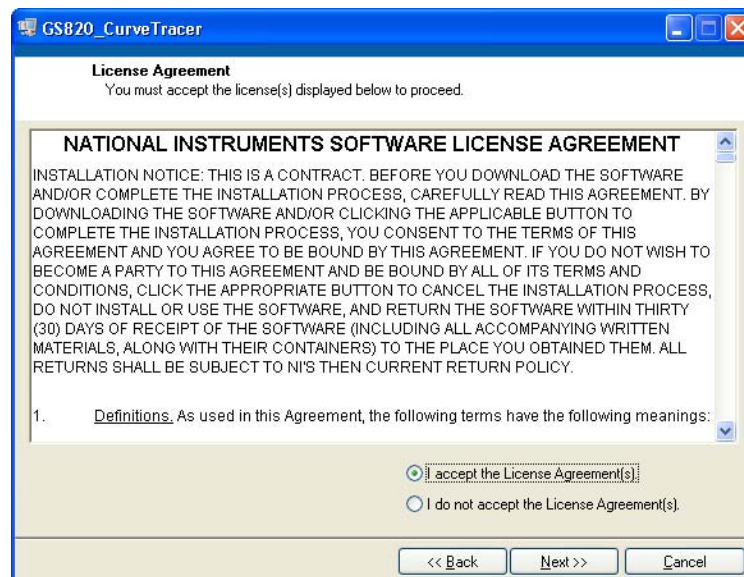
## 2.1 Installing and Uninstalling the Software

5. Select the installation directory, and click **Next**. You can click **Browse** to change the installation directory.

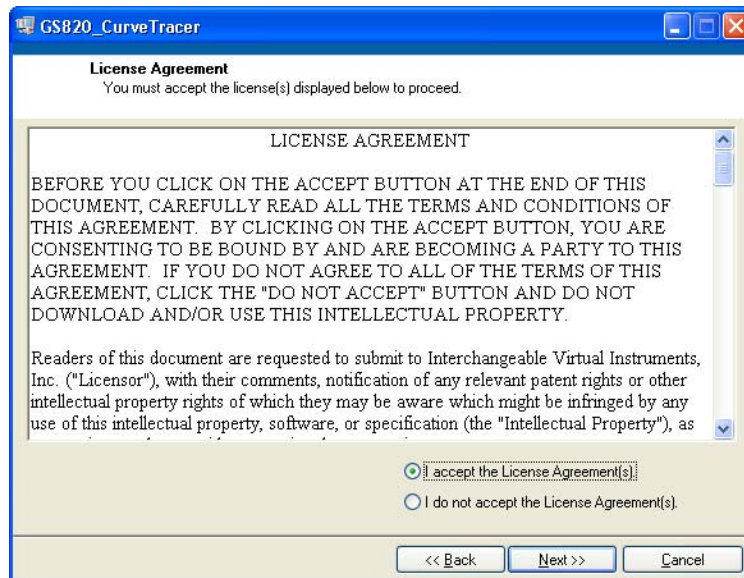
The default Curve Tracer Software directory is shown in the figure below.



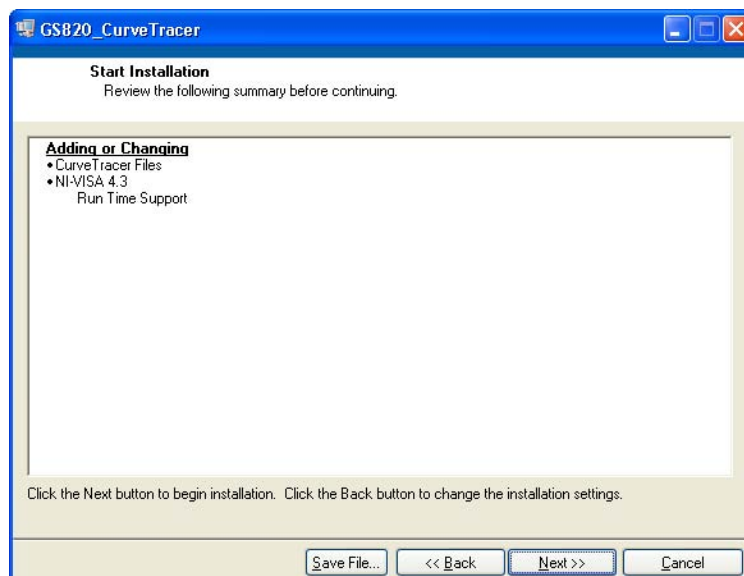
6. If you accept the License Agreement, select **I accept the License Agreement(s)** and click **Next**.



7. If you accept the License Agreement, select **I accept the License Agreement(s)** and click **Next**.

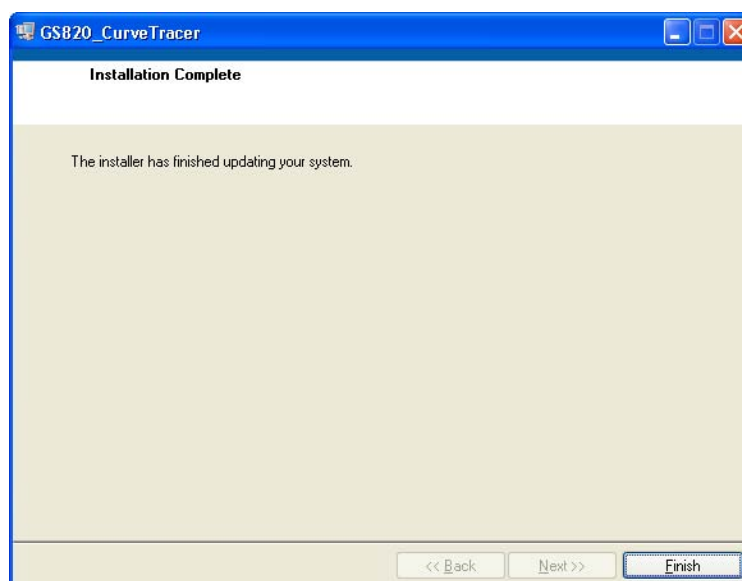


8. A list of the software that will be installed appears. Click **Next** to begin the installation of the software.



## 2.1 Installing and Uninstalling the Software

9. If the installation finishes successfully, the following window appears. Click **Finish**.



10. If the runtime library was also installed, a window will appear asking you to restart your computer. Click **Restart**.



Once the installation is finished, you can access the GS610\_CurveTracer and GS820\_CurveTracer shortcuts by clicking Start > All Programs > Yokogawa > CurveTracer. The CurveTracer Manual shortcut (which can be used to access a PDF of the User's Manual) also appears in the same location as the CurveTracer shortcut. After installation is finished, the following files will be installed in the installation directory you specified in step 5. The default installation directory is C:\Program Files\Yokogawa\CurveTracer\.

- GS610\_CurveTracer.exe
- GS820\_CurveTracer.exe
- CurveTracerManual.pdf
- Sample Setup\
  - FET Id-Vds.txt
  - FET Id-Vgs.txt
  - LED.txt
  - NPN hFE-Ic.txt
  - NPN Ib-Vbe.txt
  - NPN Ic-Vce.txt
  - NPN Vbe(sat)-Ic.txt
  - NPN Vce(sat)-Ic.txt
  - VREG Vo-Io.txt



### Uninstalling the Software

Uninstall the software in the Add or Remove Programs window of the Windows Control Panel.

This section explains how to uninstall the software on Windows XP.

1. Click **Start**, and then click **Control Panel**.
2. Double-click **Add or Remove Programs** in the **Control Panel**.
3. Select **Curve Tracer** in the Add or Remove Programs window, and then click **Remove**.
4. A window will appear to confirm that you want to remove the program. To remove the program, click **Yes**. If you click **No**, the program will not be removed.
5. The software uninstallation begins.

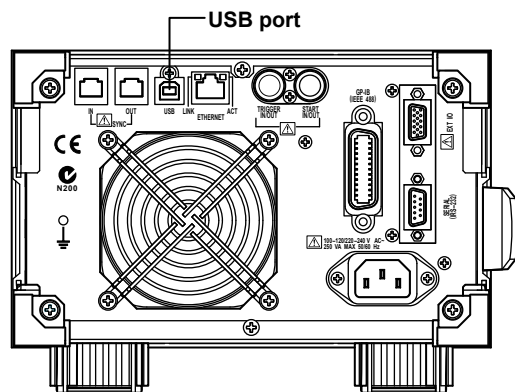
#### **Note**

Performing the above uninstallation procedure will not uninstall the runtime library (NI-VISA Runtime). To uninstall the runtime library (NI-VISA Runtime), select National Instruments Software in the Add or Remove Programs window, and then execute uninstallation.

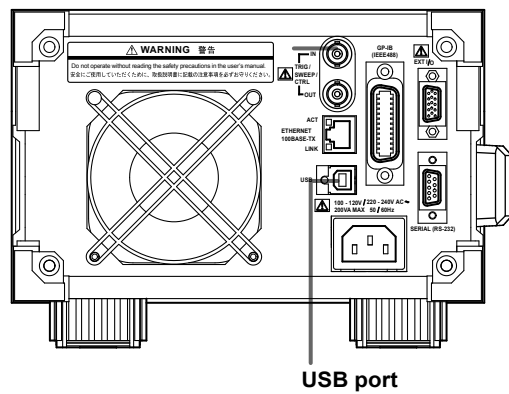
## 2.2 Connecting the GS to a PC

Connect the GS to a PC using an AB-type USB 2.0 standard cable.

## GS820 Rear Panel



## GS610 Rear Panel



## 2.3 Matching GS CSV Setting to the PC

Set the GS CSV setting to match the decimal point and separator symbols of the PC language setting.

### On the GS820

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.

Remote I/F	External I/O	LineFreq Auto	Display 4	CSV Setting	Next 1/2
---------------	-----------------	------------------	--------------	----------------	-------------

2. Press the **CSV Setting** soft key to display a menu for selecting the CSV file format.

				DecPoint	Separate
				.	,

3. Press the **DecPoint** or **Separate** soft key to select the CSV file format. The two soft keys are linked.

PC		GS820
Decimal point symbol	.	DecPoint
Separator symbol	,	Separate
Decimal point symbol	.	DecPoint
Separator symbol	,	Separate

### On the GS610

1. Press **MISC**. The MISC menu appears.

Remote I/F	Setup	Error Log	Wire 4W 2W	CSV Setting	System
---------------	-------	--------------	---------------	----------------	--------

2. Press the **CSV Setting** soft key to display a menu for selecting the CSV file format.

				DecPoint	Separate
				.	,

3. Press the **DecPoint** or **Separate** soft key to select the CSV file format. The two soft keys are linked.

PC		GS610
Decimal point symbol	.	DecPoint
Separator symbol	,	Separate
Decimal point symbol	.	DecPoint
Separator symbol	,	Separate

Because this setting is retained even after the GS power has been turned off, you do not have to reconfigure this setting each time you turn on the GS.

## 2.4 Setting the GS USB Mode to USB-TMC

To connect the GS to a PC through USB, operate the GS and set its USB mode to “USB-TMC.”

### On the GS820

1. Press **SHIFT+SETUP (MISC)**. The MISC menu appears.

Remote I/F	External I/O	LineFreq Auto	Display 4	CSV Setting	Next 1/2
---------------	-----------------	------------------	--------------	----------------	-------------

2. Press the **Remote I/F** soft key. The Remote I/F menu appears.

GPIB 1	RS232	LAN	USB Storage	VISA Info
-----------	-------	-----	----------------	--------------

### Setting the USB Interface Mode

3. Press the **USB** soft key. The USB menu appears.

			USB Mode Storage USB-TMC	
--	--	--	-----------------------------	--

4. Press the **USB-TMC** soft key.

### On the GS610

1. Press **MISC**. The MISC menu appears.

Remote I/F	Setup	Error Log	Wire 4W 2W	CSV Setting	System
---------------	-------	--------------	---------------	----------------	--------

2. Press the Remote I/F soft key. The Remote I/F menu appears.

GPIB 1	RS232	LAN	USB Storage		
-----------	-------	-----	----------------	--	--

### Setting the USB Interface Mode

3. Press the **USB** soft key. The USB menu appears.

			USB Mode Storage USB-TMC	
--	--	--	-----------------------------	--

4. Press the **USB-TMC** soft key.

Because this setting is retained even after the GS power has been turned off, you do not have to reconfigure this setting each time you turn on the GS.

## 2.5 Connecting the GS through USB and Installing It as New Hardware

After you install the Curve Tracer Software and the VISA Runtime library, connect the GS to the PC through USB. The first time you connect the GS, the PC will recognize it as a new USB Test and Measurement Device, and the Found New Hardware Wizard will appear. Follow the procedure below to install the software for the GS. (In Windows Vista, the software will be installed automatically and the Found New Hardware Wizard will not appear.)

1. Select **No, not this time**, and click **Next**.



2. Select **Install the software automatically (Recommended)**, and click **Next**.



## 2.5 Connecting the GS through USB and Installing It as New Hardware

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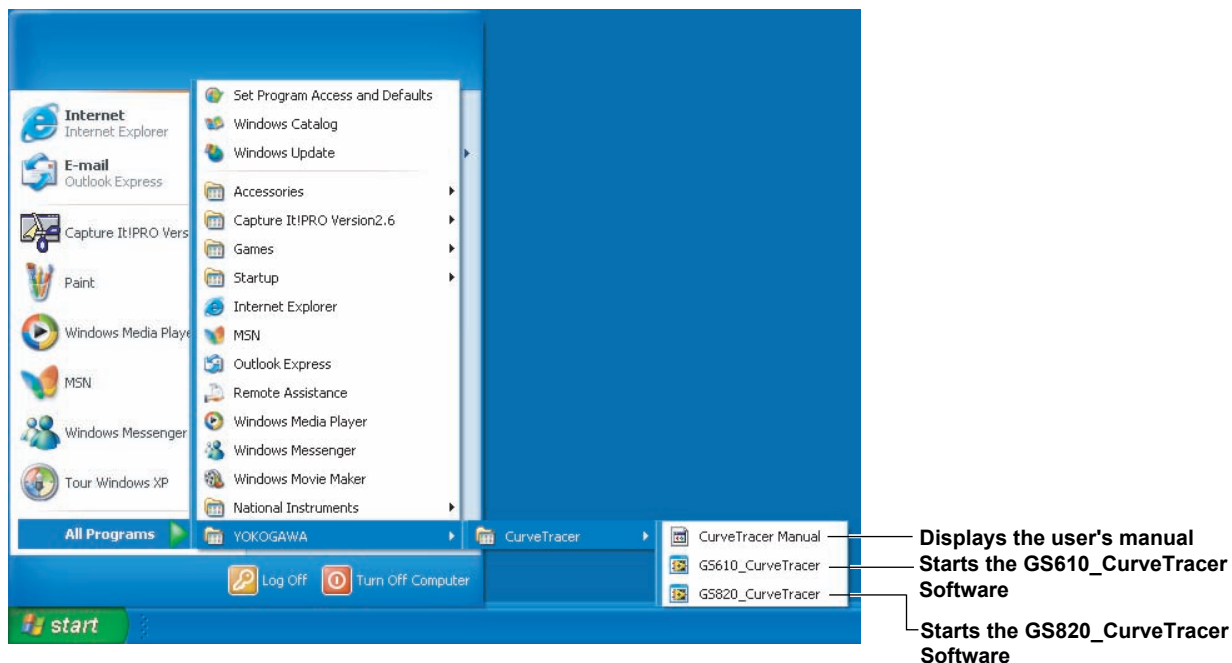
3. If the hardware installation finishes successfully, the following page appears. Click **Finish**.



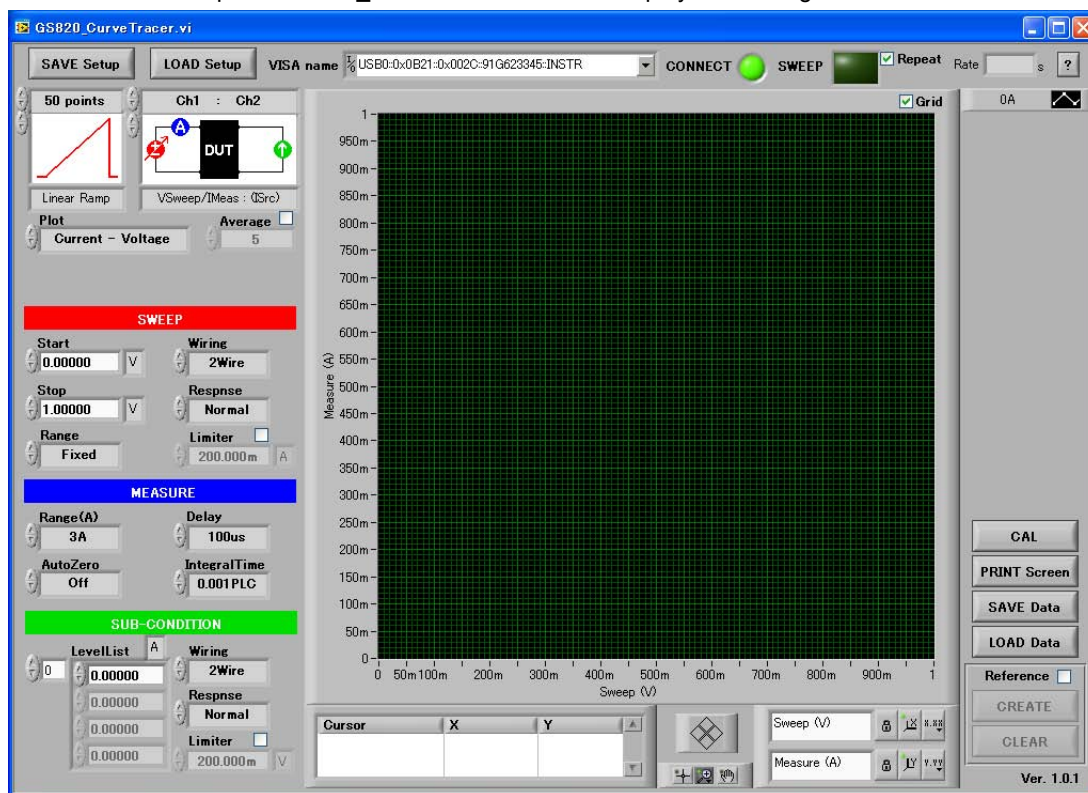
## 3.1 Starting and Closing the Software

### Starting the Software

1. Click **Start > All Programs > Yokogawa > CurveTracer > GS820\_CurveTracer** or **GS610\_CurveTracer**. The Curve Tracer Software starts.




Example of GS820\_CurveTracer Software Display after Being Started

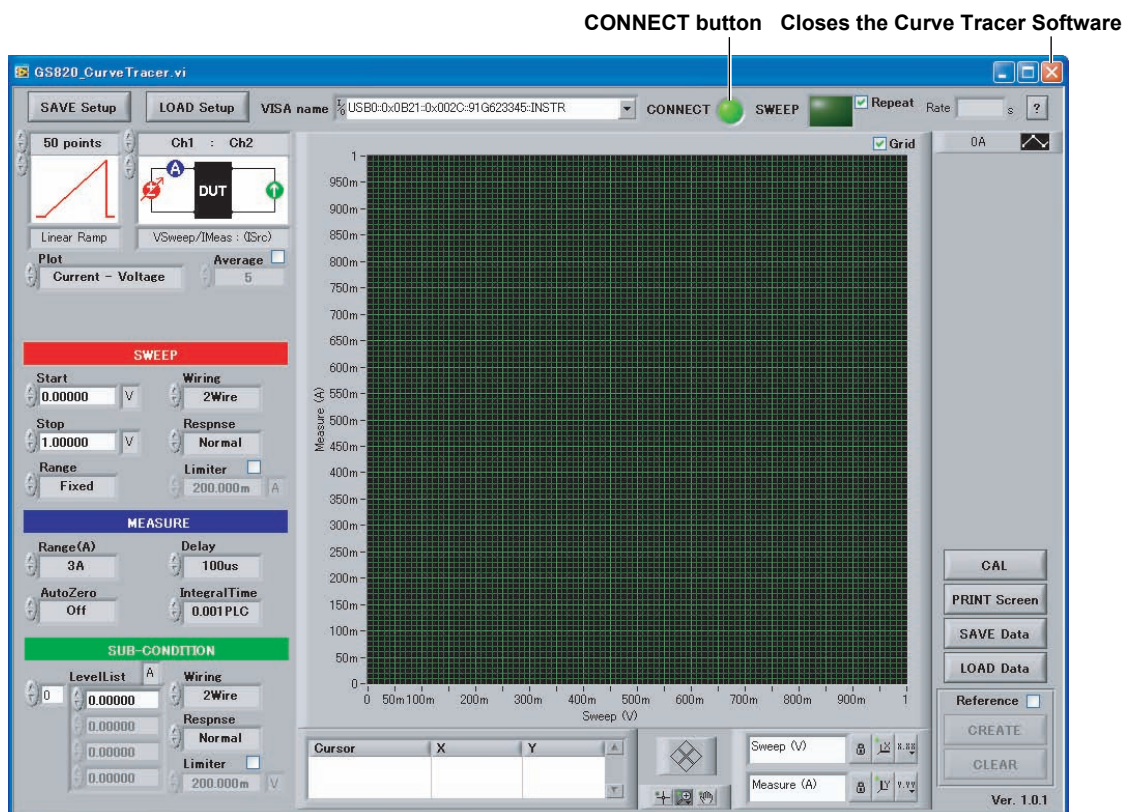




### 3.1 Starting and Closing the Software

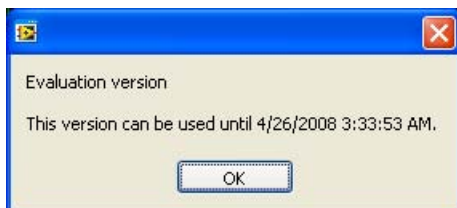
#### Closing the Software

1. Before closing the software, click the CONNECT button to disconnect the GS from the PC. Even if the sweep operation is in progress, sweeping will stop automatically and the GS will stop transmitting data. After the GS has been disconnected from the PC, the CONNECT button light turns off.
2. After disconnecting the GS from the PC, click  in the upper right of the Curve Tracer Software window. The Curve Tracer Software closes.



#### Note

If you download the beta version of the Curve Tracer Software from the YOKOGAWA homepage, the trial period lasts for 30 days after you first start it. The following window appears each time you start the Curve Tracer Software during the trial period. Click OK.



After the 30-day trial period has expired, the following window appears. Click OK to close the Curve Tracer Software.





## 3.2 Basic Operations

GS820\_CurveTracer Window

**Setting area (see chapter 5 for details)**  
Contains all of the boxes and buttons for source and measurement settings.

**Setup data save button**  
(See section 5.6 for details)

**Setup data load button**  
(See section 5.7 for details)

**Operation control area**

- VISA name (see section 4.1 for details)
- CONNECT button (see section 4.2 for details)
- SWEEP operation control button (see section 6.1 for details)
- Update rate display (see section 6.1 for details)

**Plot legend**  
(See section 7.2 for details)

**Graph display area**

**Graph setting area (see chapter 7 for details)**  
Contains all of the boxes and buttons for graph settings.

- Cursor legend: Configures individual cursor settings (see section 7.3 for details)
- Cursor control buttons: Move the active cursor (see section 7.3 for details)
- Mouse control: Determines what action is performed when the mouse is dragged (see sections 7.3 to 7.5 for details)
- Scale legend: Configures the X-axis and Y-axis scales (see section 7.6 for details)
- Reference: Reference feature (see section 7.8 for details)
- CREATE: Creates a reference plot
- CLEAR: Clears all reference plots

**Report feature area (see chapter 8 for details)**

- PRINT Screen: Saves a screen capture (section 8.1 for details)
- SAVE Data: Saves measured data (see section 8.3 for details)
- LOAD Data: Loads measured data (see section 8.4 for details)

**CAL: Calibration (see section 9.1 for details)**

## 3.2 Basic Operations

**GS610\_CurveTracer Window**

**Setting area (see chapter 5 for details)**  
Contains all of the boxes and buttons for source and measurement settings.

**Setup data save button (See section 5.6 for details)**

**Setup data load button (See section 5.7 for details)**

**Operation control area**

- VISA name (see section 4.1 for details)
- CONNECT button (see section 4.2 for details)
- SWEEP operation control button (see section 6.1 for details)
- Update rate display (see section 6.1 for details)

**Plot legend (See section 7.2 for details)**

**Graph display area**

**Graph setting area (see chapter 7 for details)**  
Contains all of the boxes and buttons for graph settings.

- Cursor legend: Configures individual cursor settings (see section 7.3 for details)
- Cursor control buttons: Move the active cursor (see section 7.3 for details)
- Mouse control: Determines what action is performed when the mouse is dragged (see sections 7.3 to 7.5 for details)
- Scale legend: Configures the X-axis and Y-axis scales (see section 7.6 for details)
- Reference: Reference feature (see section 7.8 for details)
- CREATE: Creates a reference plot
- CLEAR: Clears all reference plots

**Report feature area (see chapter 8 for details)**

- PRINT Screen: Saves a screen capture (section 8.1 for details)
- SAVE Data: Saves measured data (see section 8.3 for details)
- LOAD Data: Loads measured data (see section 8.4 for details)

**CAL: Calibration (see section 9.1 for details)**

### Note

The GS610\_CurveTracer window is different from the GS820\_CurveTracer window in the following ways:

- There are two VISA name boxes, because up to two GS610s can be connected to a PC.
- There are no response mode boxes under SWEEP or SUB-CONDITION.
- The units of the IntegralTime box under MEASURE are  $\mu$ s and ms instead of PLC.

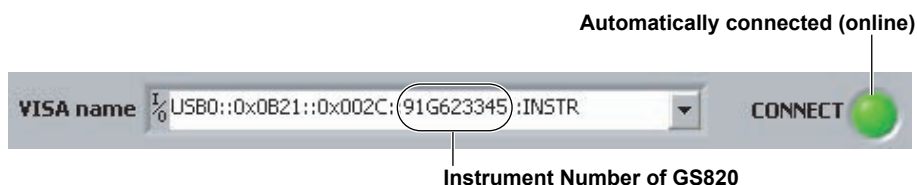
## 4.1 Selecting the Communication Path (VISA name)

This section explains how to select a VISA name and establish a communication path.

### In GS820\_CurveTracer

#### When One GS820 Is Connected to a PC through USB

The VISA name is selected automatically, and the PC connects to the GS820. You do not need to perform any connection operations.

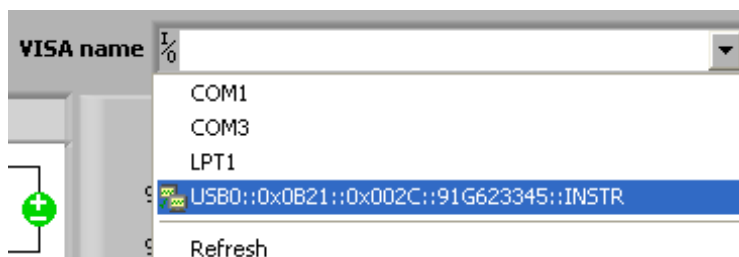


#### When Multiple GS820s Are Connected to a PC through USB

Click the down arrow next to the VISA name box, and select the VISA name of the GS820 that you want to connect to the PC from the list.

The VISA name for a GS that is connected through USB appears as shown below:

USB0::0x0B21::0x002C::<Instrument Number of GS>::INSTR



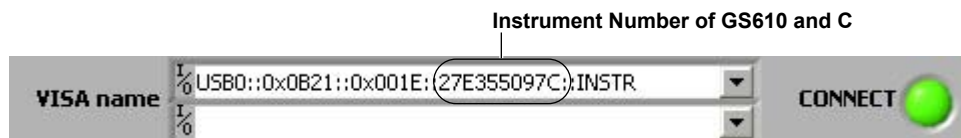
You must also perform the above operation if you connect the GS820 and the PC or turn on the GS820 after you start the Curve Tracer Software.

#### 4.1 Selecting the Communication Path (VISA name)

### In GS610\_CurveTracer

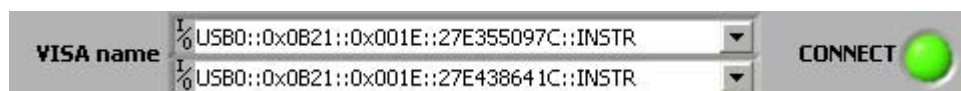
#### When One GS610 Is Connected to a PC through USB

The name in the upper VISA name box (CH1) is selected automatically, and the PC connects to the GS610. You do not need to perform any connection operations. The sub-channel cannot be used in curve trace operations.



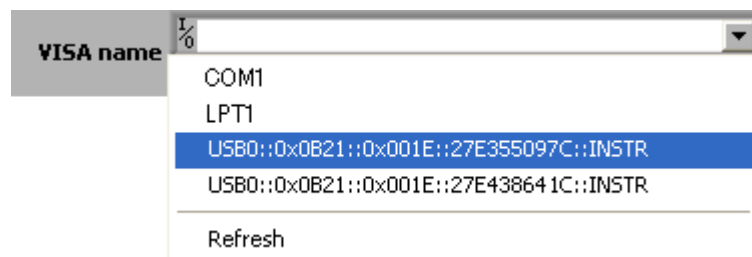
#### When Two GS610s Are Connected to a PC through USB

The names in the upper and lower VISA name boxes (CH1 and CH2) are selected automatically, and the PC connects to the two GS610s. You do not need to perform any connection operations. The GS610 with the smaller Instrument number is assigned to CH1.



#### When Three or More GS610s Are Connected to a PC through USB

For both the upper and lower VISA name boxes, click the down arrow, and select the VISA name of the GS610 that you want to connect to the PC from the list.

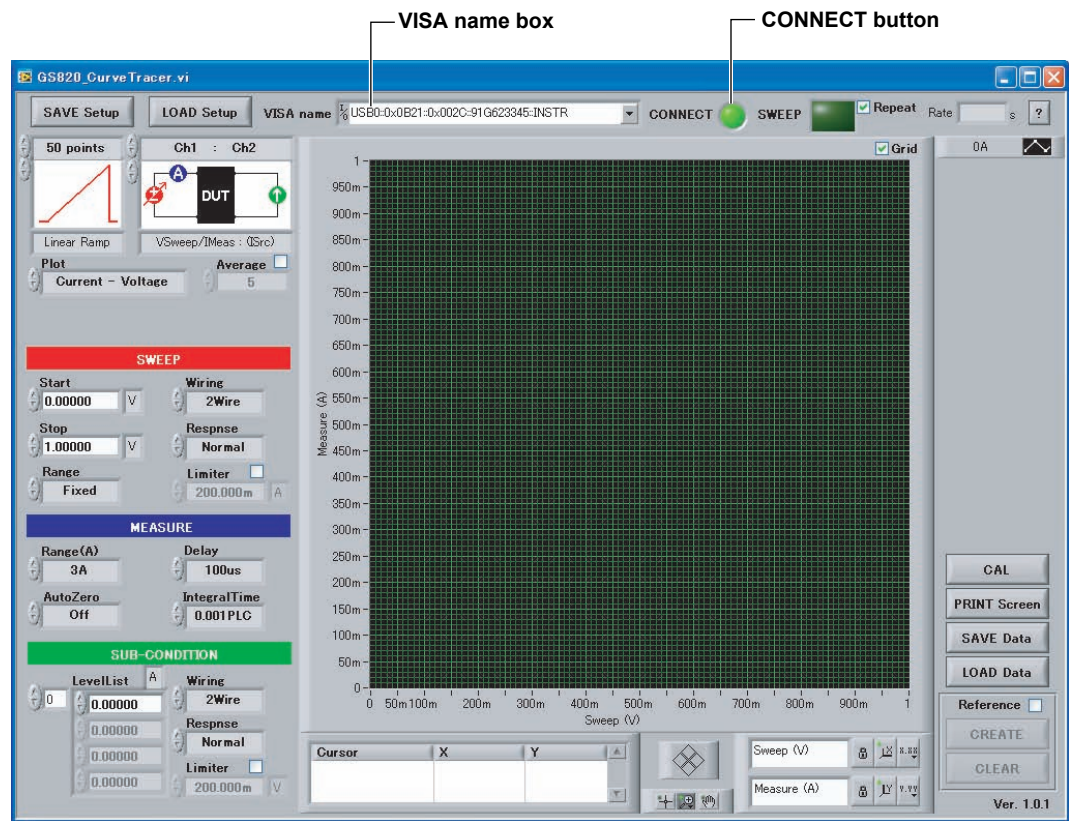


The VISA name for a GS that is connected through USB appears as shown below:  
USB0::0x0B21::0x001E::<Instrument Number of GS610>C::INSTR

You must also perform the above operation if you connect the GS610 and the PC or turn on the GS610 after you start the Curve Tracer Software.



## 4.2 Connecting and Disconnecting the GS



4

Connecting the GS to a PC

### Connecting the GS

Click the CONNECT button. The CONNECT button lights in green, indicating that the GS is online.



### Disconnecting the GS

Click the CONNECT button. The CONNECT button light turns off, indicating that the GS is offline.



Disconnect the GS before changing the VISA name or closing the Curve Tracer Software.

## 4.2 Connecting and Disconnecting the GS

---

The message shown below appears when the GS is not connected properly. If this message appears, check that the USB cable is connected properly and that the GS USB mode is set to USB-TMC.



## 5.1 Basic Setting Area Operations

**Basic source and sweep settings**  
(see section 5.2 for details)

- Sweep points
- Sweep form

**Sweep settings**  
(see section 5.3 for details)

- Sweep start level
- Sweep stop level
- Sets the source range mode to Fixed or Auto

**Measurement settings**  
(see section 5.4 for details)

- Measurement range
- Turns the auto-zero feature on or off

**Sub-channel settings**  
(see section 5.5 for details)

- Level list

**Channel configuration**

**Circuit configuration**  
(sets the functions of each channel)

Turns graph averaging on or off

Number of averaged values

Channel coefficient<sup>\*1</sup>

**Wiring system**

**Response mode<sup>\*2</sup>**

Turns the limiter on or off

Limiter level

**Measurement delay**

**Integration time**

**Wiring system**

**Response mode<sup>\*2</sup>**

Turns the limiter on or off

Limiter level

\*1 The channel coefficient only appears when the circuit configuration box shows one of the circuit configurations listed below. The coefficient is only displayed in the figure above so that the entire setting area can be explained.


- ISweep/VMeas - ISweep
- ISweep - ISweep/VMeas

\*2 GS610\_CurveTracer does not have response mode boxes.

Types of Buttons and Boxes in the Setting Area


The setting area contains the following kinds of buttons and boxes.

**List box**




Gray

**Combo box**




**Number box**



White


**Picture box**



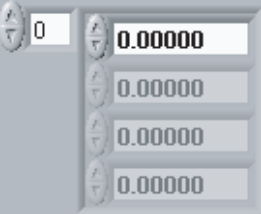
**Check box**

Average ☐

**Button**

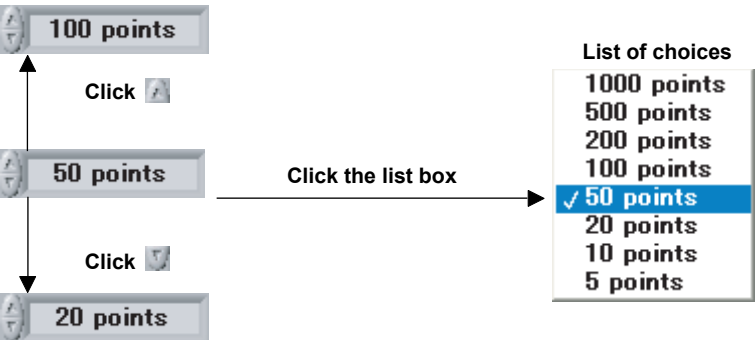


**List of number boxes**



Changing List Box Settings

Click a list box to display a list of options. Use the up and down arrows next to the list box to change the selected option in the listed order.

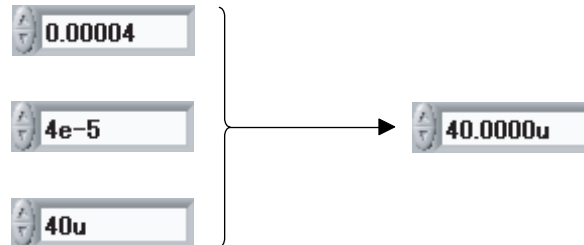




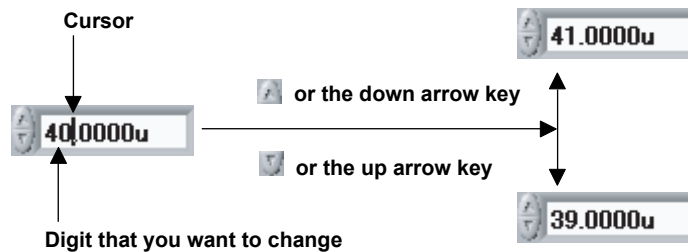
### Setting Number Boxes

Click the number box that you want to set, and enter a value. You can use the letter E to enter exponents. You can also enter unit prefixes (such as p, n, u, and m). Exponents are displayed in multiples of three (for example, E±6 or E±9).

Example: To set a number box to 0.00004, you can enter 0.00004, 4e-5, or 40u. The display will show 40.0000u.

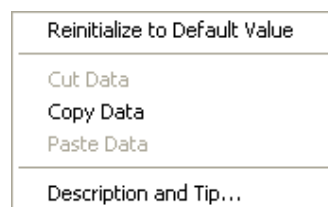


To increase or decrease part of a set number, click the digit that you want to change, or use the left and right keyboard arrows to move the cursor to the digit. The digit to the left of the cursor will be changed. Click the number box's up and down buttons or use the up and down arrow keys on the keyboard to change the value of the digit.

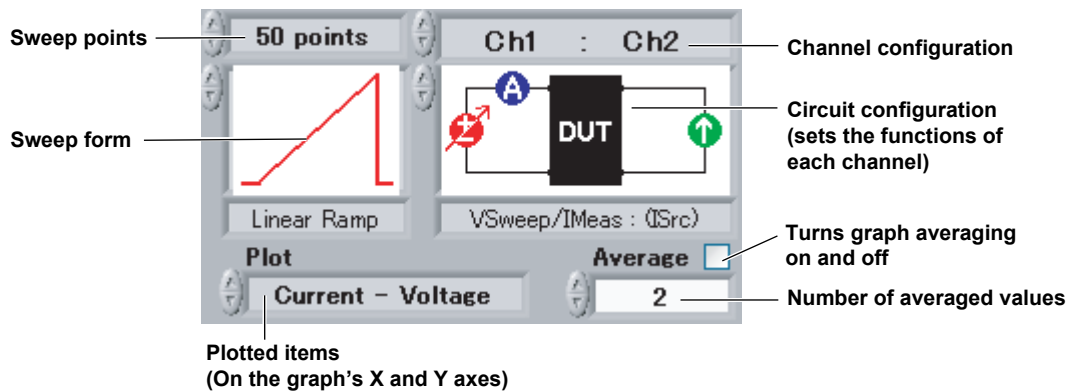


### Initializing Settings; Cutting, Copying, and Pasting Values; and Viewing Descriptions and Tips

Right-click a box, and then click the action that you would like to perform.

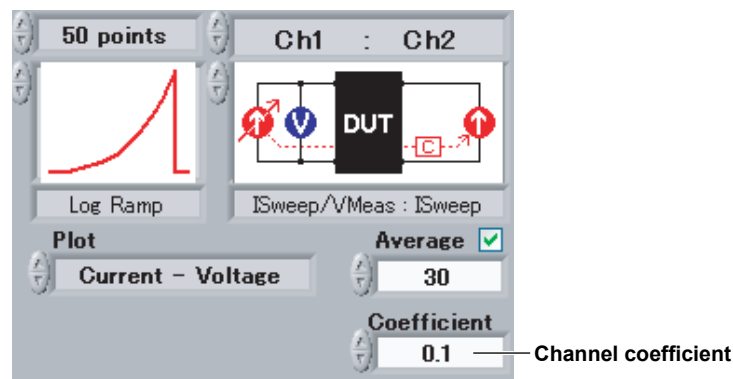


## 5.2 Configuring Basic Source and Measurement Settings



The channel coefficient appears when the circuit configuration box shows one of the circuit configurations listed below. The software multiplies the sweep channel levels by the channel ratio to determine the sub-channel levels. Simultaneous sweeping can be performed on both the sweep channel and the sub-channel.

- ISweep/VMeas - ISweep
- ISweep - ISweep/VMeas



### Sweep Points

The number of sweep points determines the number of divisions between the sweep start and sweep stop levels (the sweep range).

You can set the number of sweep points to one of the following values:

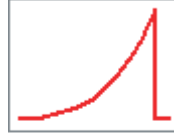
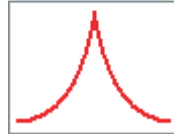
5, 10, 20, 50, 100, 200, 500, or 1000.

When the sweep form is set to Linear Triangle or Log Triangle, the set value determines the number of sweep points on both the rising and falling slopes. Therefore, the number of sweep points in an entire period is as follows:

$$\text{Sweep point setting} \times 2 - 1$$

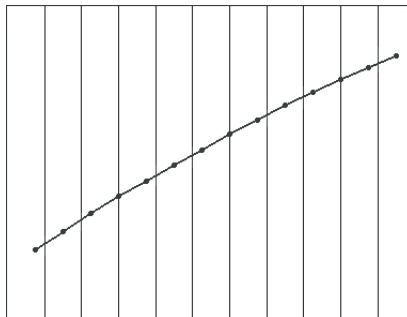
**Sweep Forms**

You can choose one of the following five kinds of sweep forms:

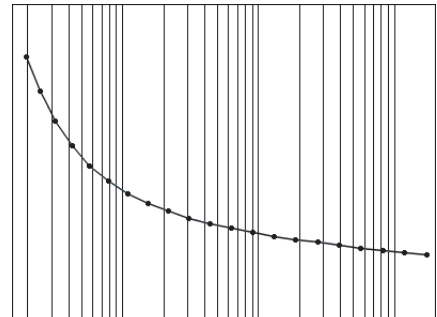
**Linear Ramp****Linear ramp waveform****Log Ramp****Logarithmic ramp waveform****Linear Triangle****Linear triangular waveform****Log Triangle****Logarithmic triangular waveform****Pulse****Pulse waveform****Note**

- To plot a sweep evenly, view linear sweep forms using the linear scale and log sweep forms using the log scale.

**Linear scale**  
**Linear sweep**

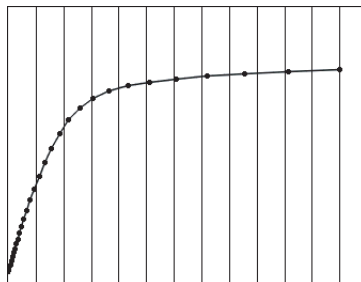


**Log scale**  
**Log sweep**



- In cases such as when the measured value changes suddenly around zero, a log sweep form may be more appropriate even when the sweep scale is linear.

**Linear scale**  
**Log sweep**



- Select a triangle form when viewing the hysteresis of the DUT.
- Select the pulse form when measuring the pulse response characteristics of the DUT.

### Channel Configuration

Assign the functions on the left and right sides of the circuit configuration box to channel 1 or channel 2 (the function diagram is used to set the functions of each channel).

Ch1 : Ch2 Sweep channel<sup>1</sup> = Ch1. Sub-channel<sup>2</sup> = Ch2.

Ch2 : Ch1 Sweep channel = Ch2. Sub-channel = Ch1.

#### 1 Sweep channel

The channel of the voltage or current undergoing the sweep operation.

#### 2 Sub-channel

Use the sub-channel when you want to apply a voltage or current to the DUT in addition to the voltage or current on the sweep channel. There are two ways that you can use the sub-channel.

- To generate a constant voltage or current.

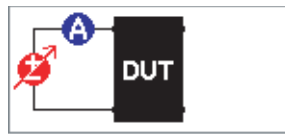
For example, you can use it to produce the  $V_{GS}$  when measuring the  $I_D$ - $V_{DS}$  characteristics of an FET.

- Create a sweep of the voltage or current undergoing the sweep operation multiplied by the channel coefficient.

For example, you can measure the  $V_{BE(sat)}$  characteristics of a transistor, by simultaneously sweeping  $I_C$  on the sweep channel and  $I_B$  on the sub-channel with a coefficient that satisfies the saturation condition (for example, 0.1).

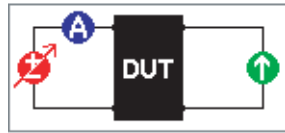
### Circuit Configurations

Click the circuit configuration box to display a list of circuit configurations. Use the up and down arrows next to the circuit configuration box to select the appropriate option.



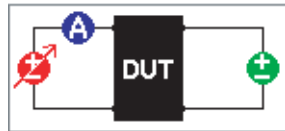
#### VSweep/IMeas-OFF

The voltage is swept, and the current is measured. The sub-channel is not used.



#### VSweep/IMeas -(Isrc)

The voltage is swept, and the current is measured. A constant current is applied to the sub-channel.



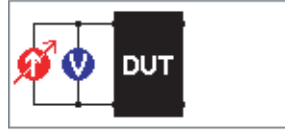
#### VSweep/IMeas -(Vsrc)

The voltage is swept, and the current is measured. A constant voltage is applied to the sub-channel.



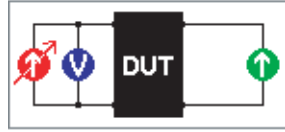
#### VSweep -(Vsrc)/IMeas

The voltage is swept, and the sub-channel current is measured. A constant voltage is applied to the sub-channel.



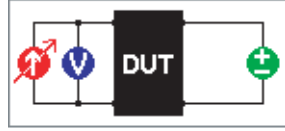
#### ISweep/VMeas -OFF

The current is swept, and the voltage is measured. The sub-channel is not used.



#### ISweep/VMeas -(Isrc)

The current is swept, and the voltage is measured. A constant current is applied to the sub-channel.



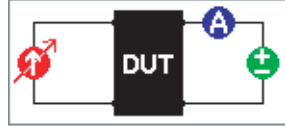
#### ISweep/VMeas -(Vsrc)

The current is swept, and the voltage is measured. A constant voltage is applied to the sub-channel.



#### ISweep -(Isrc)/VMeas

The current is swept, and the sub-channel voltage is measured. A constant current is applied to the sub-channel.



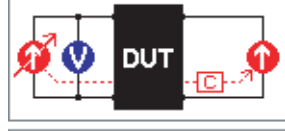
#### ISweep -(Vsrc)/IMeas

The current is swept, and the sub-channel current is measured. A constant voltage is applied to the sub-channel.



#### VSweep -(Isrc)/VMeas

The voltage is swept, and the sub-channel voltage is measured. A constant current is applied to the sub-channel.



#### ISweep/VMeas -ISweep

The sweep-channel and sub-channel currents are swept simultaneously (using the channel coefficient) and the sweep channel's voltage is measured.



#### ISweep -ISweep/VMeas

The sweep-channel and sub-channel currents are swept simultaneously (using the channel coefficient) and the sub-channel's voltage is measured.

## 5.2 Configuring Basic Source and Measurement Settings

### Plot Box to Select What Items to Plot

Specify which items will be represented on the X and Y axes when the measured results are graphed.

	Y-Axis	X-Axis
Current - Voltage	Current	Voltage
Voltage - Current	Voltage	Current
Measure - Time	Measured value	Timestamp
Gain - Measure*	Gain	Measured value
	Use to plot the hFE-Ic characteristics of a transistor.	
Gain - Sweep*	Gain	Sweep value
Measure - Sweep*	Measured value	Sweep value

\* Gain - Measure, Gain - Sweep, and Measure - Sweep only appear when the circuit configuration box shows one of the circuit configurations listed below.

ISweep - (VSrc)/IMeas

VSweep - (ISrc)/VMeas

The gain is computed using the equation below.

$$\text{Gain} = \frac{\text{Meas (the measured value)}}{\text{Sweep (the sweep value)}}$$

### Note

If you execute the sweep operation while a graph is displayed and change the plotted items, the graph will be cleared. The new items are plotted the next time that the sweep operation is executed.

### Average Check Box to Turn Graph Averaging On and Off

Moving averages are computed. Averaging is useful when the graph of measured results fluctuates greatly because of noise and other factors.

- Turning graph averaging on and off

The settings available for graph averaging are as follows:

Off      Averaging is not performed.

On      Averaging is performed.

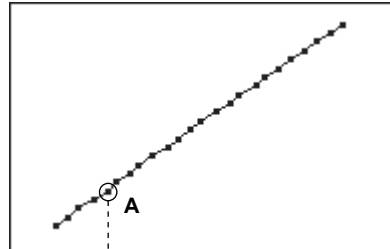
- Number of averaged values

2 to 100

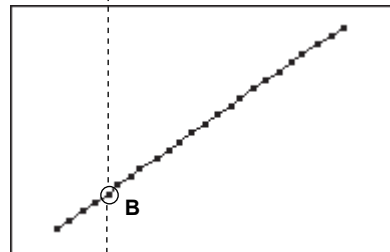
The higher the number of averaged values, the more stable the graph of the measured results. However, measurement also takes longer as the number of averaged values increases.

**Averaging Operation Example**

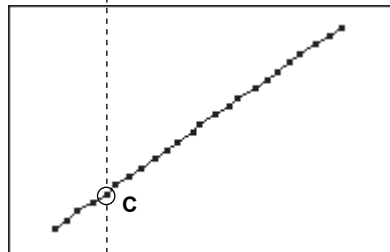
If you set the number of averaged values to 3 and execute measurement, three sweeps are executed, and the measured graph results from those three sweeps are stored in the Curve Tracer Software. The software averages the three plots of the measured data and displays the resulting value in the graph.



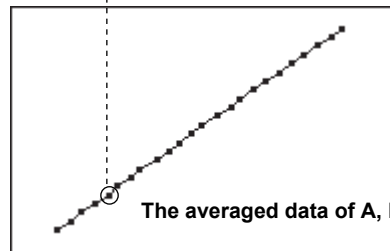
Measured results of the first sweep  
(Graphs are not displayed.  
The data is stored in the software.)



Measured results of the second sweep  
(Graphs are not displayed.  
The data is stored in the software.)



Measured results of the third sweep  
(Graphs are not displayed.  
The data is stored in the software.)



The averaged data of A, B, and C is plotted.

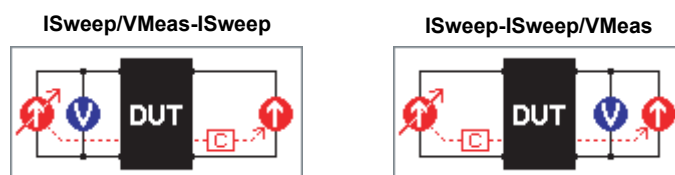
The three measured data plots shown  
above are averaged, and the average  
is graphed. Averaging the fluctuations  
in single measurements results  
in a more stable graph.

For the operation that is performed when Repeat (repeating measurement) is on, see section 6.1.

## 5.2 Configuring Basic Source and Measurement Settings

### Channel Coefficient in the Coefficient Box

The channel coefficient appears when the circuit configuration box shows one of these connections:

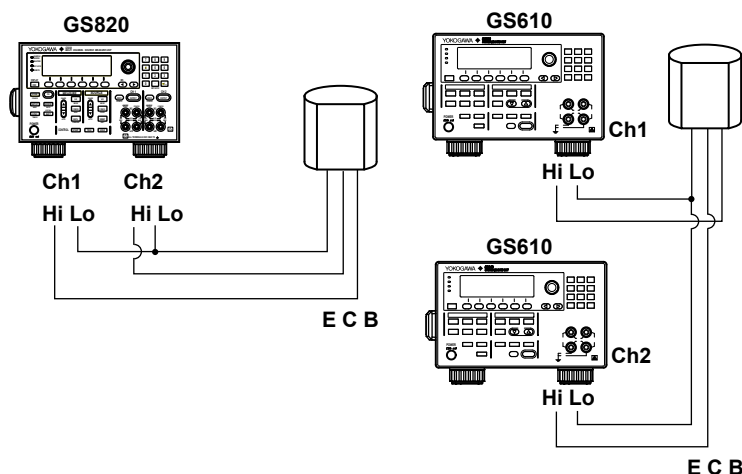
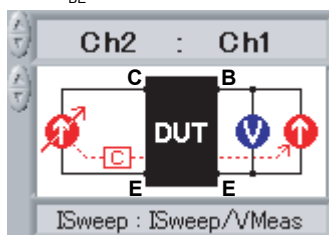


Use the channel coefficient to set the current ratio between the channels on each side of the circuit configuration during a dual-channel simultaneous current sweep operation. The channel coefficient can be used to measure the  $V_{CE(sat)}$  and  $V_{BE(sat)}$  of a transistor.

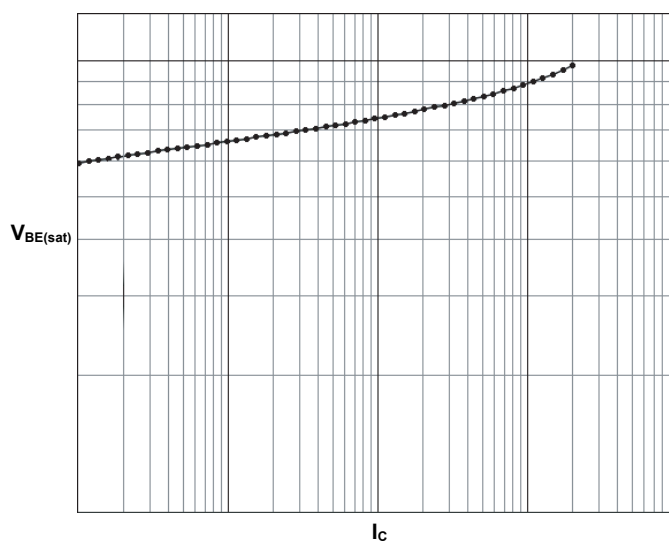
Example: Measuring the  $V_{BE(sat)}$

Make connections and configure the channel and circuit configuration settings as shown in the figure below.

- Sweep channel: Ch2  
 $I_C$  is swept
- Sub-channel: Ch1  
 $I_B$  is swept at the same time  
 $V_{BE}$  is measured

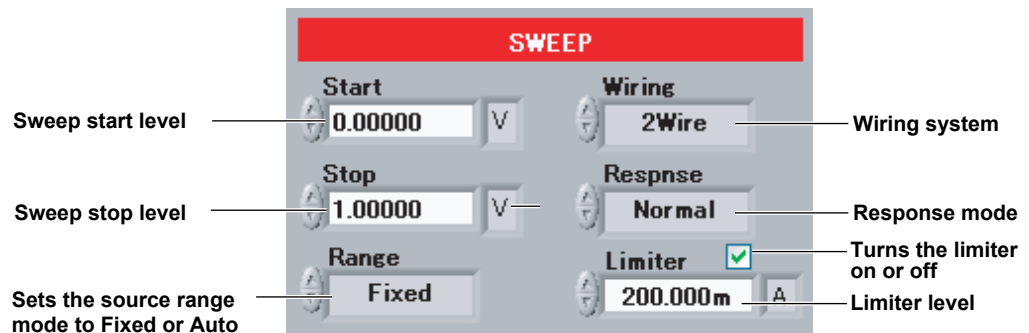


Collector current  $I_C$  is swept and measured on channel 2. Base current  $I_B$  is generated on channel 1 at the channel 2 current value multiplied by the channel coefficient ( $I_B = I_C \times \text{coefficient}$ ). The base-to-emitter saturation voltage  $V_{BE(sat)}$  is measured. Set the coefficient according to the value of  $I_B/I_C$ . If  $I_C/I_B = 10$ , set the coefficient to 0.1.





## 5.3 Configuring Detailed Sweep Source Settings



### Start: The Sweep Start Level

### Stop: The Sweep Stop Level

Whether the sweep start and stop levels are based on voltage or current is determined by the circuit configuration settings and is indicated to the right of each level.

### Range: The Sweep Source Range

**Fixed** The source range is set to the smallest range that includes the sweep start and stop levels.

**Auto** The optimum source range is set automatically for each sweep level.

In Auto, the source range may change during a sweep operation. The glitch that occurs during this change can affect the measured data. You can remove the effect of the glitch by setting the measurement delay to 5 ms or greater (see section 5.4 for details).

### Wiring: The Wiring System of the Sweep Channel

**2Wire** A system with two wires, OUTPUT Hi and Lo.

**4Wire** A system with four wires, OUTPUT Hi and Lo and SENSE Hi and Lo.

To reduce the effects of cable resistance, use the 4Wire wiring system.

### Response: The Sweep Channel Response Mode

**Normal** Normal Mode

**Stable** High-stability mode (slower response)

When the DUT load is large and oscillation occurs, selecting Stable mode may improve the condition. The response is slower in stable mode, so set a large measurement delay (see section 5.4 for details).

GS610\_CurveTracer does not have this setting.

### Limiter: The Sweep Channel Limiter

- Turning the limiter on and off

Set the sweep channel limiter operation to protect the DUT.

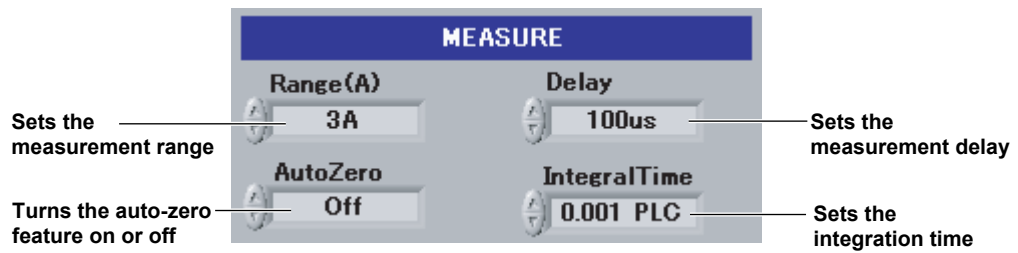
**Off** The limiter is disabled.

**On** The limiter is enabled.

- Limiter level

Set the upper limit for the limiter. Specify the current limit when the circuit configuration is set to voltage sweep and specify the voltage limit when the circuit configuration is set to current sweep. The appropriate unit appears to the right of the limit level box.

## 5.4 Configuring Detailed Measurement Settings



### Range: The Measurement Range

In GS820\_CurveTracer

Select a measurement range. You can achieve the highest resolution by selecting the smallest range that includes the range of measurement. The unit of the range (volts or amperes) is the same as the unit of the circuit configuration.

Current range options: (Auto\*), 3A, 1A, 200mA, 20mA, 2mA, 200μA, 20μA, 2μA, and 200nA

Voltage range options: (Auto\*), 18V, 7V, 2V, 200mV

\*Auto

You can select Auto if the GS820 firmware version is 1.04 or later.

When the range is set to Auto, an appropriate measurement range is selected based on the measured values. This allows for high resolution measurement within a wide range. Because of the time it takes to determine the range, measurements take longer.

In GS610\_CurveTracer

Current range options: 3A, 200mA, 20mA, 200μA, and 20μA

Voltage range options: 110V, 20V, 2V, 200mV

There is no auto range option.

### Note

- When values exceed the measurement range, they are considered infinite and are plotted outside of the graph display area. If this happens, increase the measurement range.
- When the measurement range is too wide, the resolution of the measured values is low, and the graph appears staircase shaped. If this happens, decrease the measurement range.

### AutoZero

Turn the auto-zero feature on or off. The auto-zero feature measures the internal zero reference at each measurement and adjusts the measured values.

Off The auto-zero feature is disabled.

On The auto-zero feature is enabled.

### Note

You can use the auto-zero feature to remove the offset fluctuations in measurement caused by factors such as temperature drift. However, measurement takes longer when you use the auto-zero feature.

**Delay: Measurement Delay**

Set the delay between when the sweep or sub-channel level changes and when measurement starts.

You can set the delay to 0s, 100 $\mu$ s, 200 $\mu$ s, 500 $\mu$ s, 1ms, 2ms, 5ms, 10ms, 20ms, 50ms, 100ms, 200ms, 500ms, 1s, 2s, or 5s.

Set the measurement delay to give the DUT time to stabilize between when the source level changes and when measurement starts. The longer the measurement delay, the more time measurement takes.

**IntegralTime: The Integration Time**

Set the integration time of the integrating A/D converter used in measurement.

In GS820\_CurveTracer

You can set the integration time to 0.001PLC, 0.002PLC, 0.005PLC, 0.01PLC, 0.02PLC, 0.05PLC, 0.1PLC, 0.2PLC, 0.5PLC, 1PLC, 2PLC, 5PLC, 10PLC, or 25PLC.

(PLC stands for Power Line Cycles. One PLC is equivalent to one period of the power source signal.)

In GS610\_CurveTracer

250 $\mu$ s, 1ms, 4ms, PLC, 100ms, 200ms

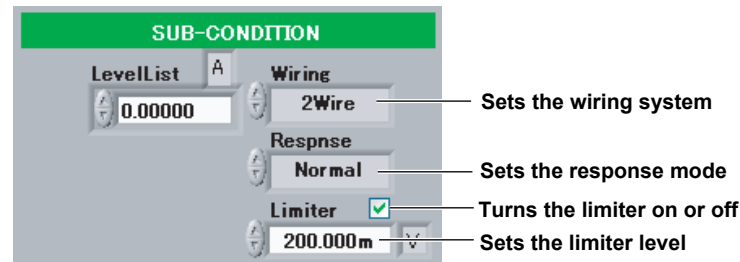
Setting a higher integration time improves the resolution and stability of measurements. Also, in cases such as when you are measuring minute current levels and the measured values are influenced by power-line noise, you can reduce the effects of noise by setting the integration time to 1 PLC or higher. On the other hand, setting a shorter integration time results in faster measurements.

## 5.5 Configuring Sub-Channel Settings

If the selected circuit configuration (see section 5.2 for details) contains the sub-channel, set the sub-channel source value. The method for setting the sub-channel source value varies depending on the circuit configuration settings (see section 5.2 for details) and whether the reference feature (see section 7.8 for details) is on or off.

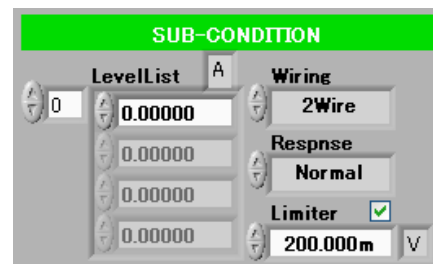
### When the Reference Feature Is On

Only one LevelList box appears.



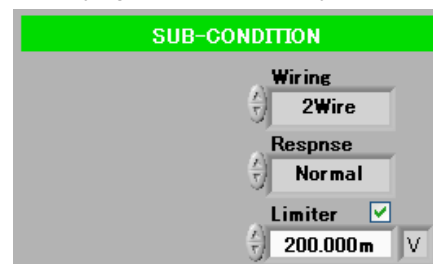
### When the Reference Feature Is Off

Four LevelList boxes appear.



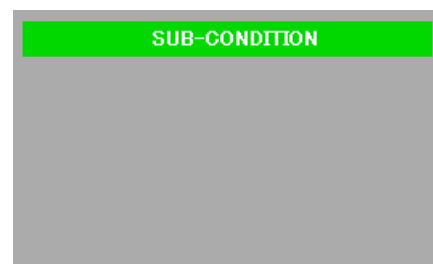
### When Performing Simultaneous Dual-Channel Sweeping

When the circuit configuration is set to simultaneous dual-channel sweeping, the LevelList box does not appear. The sub-channel is swept using a level determined by multiplying the sweep level by the channel coefficient.



### When the Sub-Channel Is Set to OFF

If the sub-channel is set to OFF in the circuit configuration, no boxes or buttons appear in the SUB-CONDITION area.



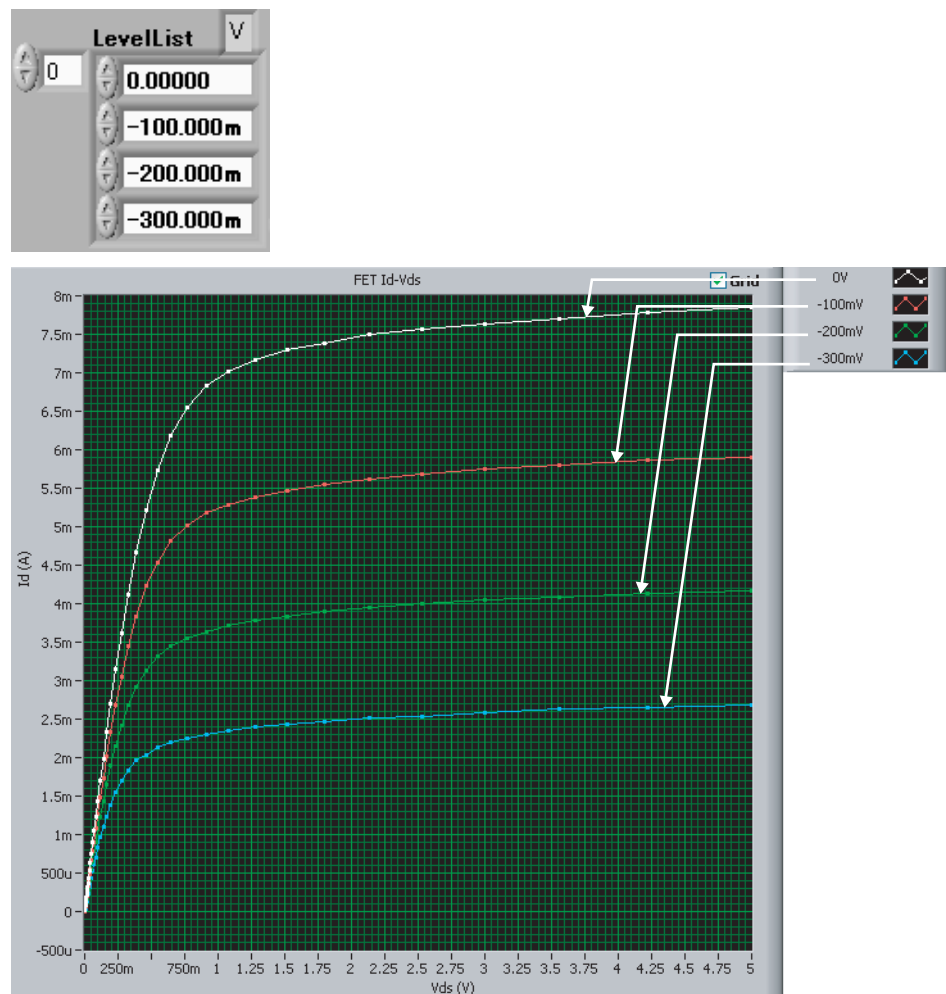
**LevelList: The Sub-Channel Source Value List****When the Reference Feature Is On (See section 7.8 for details)**

Set a single sub-channel source value that will be generated during sweeping.

**When the Reference Feature Is Off**

Set a list of the sub-channel source values that will be generated during sweeping. Each sub-channel source value in the level list will be used in order as sweeping is repeated. If no values are specified in the level list, sweeping will be performed with 0 V (or A) as the sub-channel source value.

For example, if you specify the following values in the level list when measuring the  $I_D$ - $V_{DS}$  characteristics of an N-channel junction FET, the gate voltage  $V_{GS}$  will switch between 0 V,  $-0.1$  V,  $-0.2$  V, and  $-0.3$  V.  $V_{DS}$  will be swept using the various  $V_{GS}$  settings, and  $I_D$  will be measured. Graphs of the four measured results will be displayed.



### Adding and Deleting LevelList Values

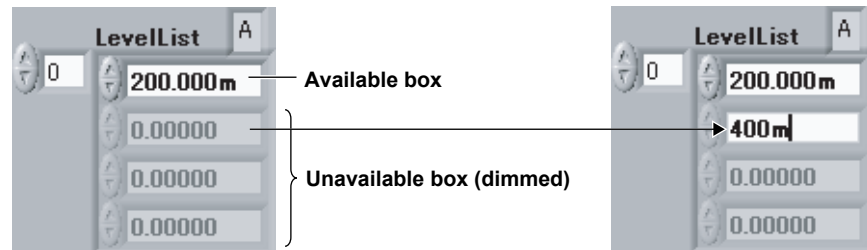
There are four LevelList boxes. Disabled LevelList boxes are dimmed. For example, in the figure below, the only sub-channel source value that is used during sweeping is 0.2 V.

- **Adding LevelList Values**

There are two ways to add LevelList values:

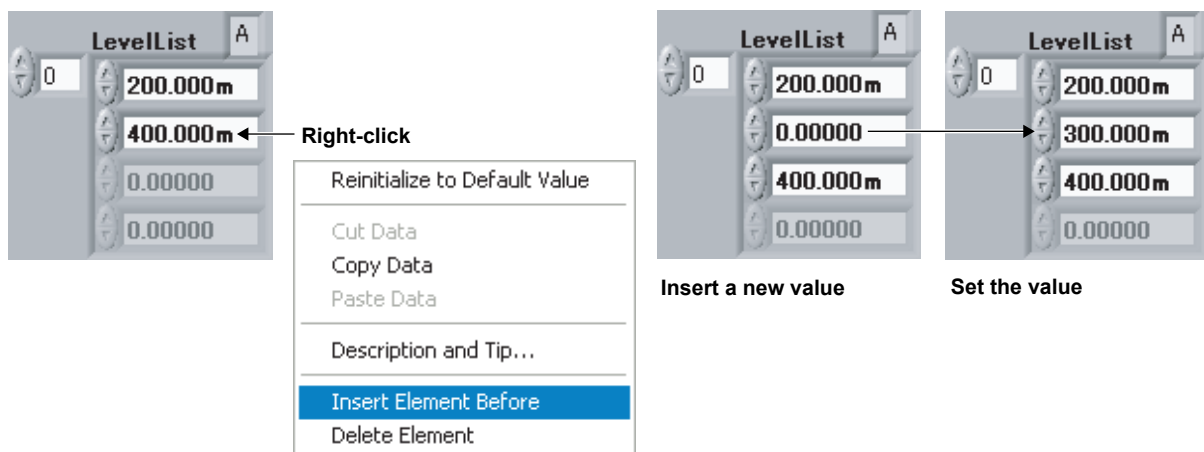
- Enabling a disabled LevelList box

Click the disabled LevelList box, and then enter a sub-channel source value.



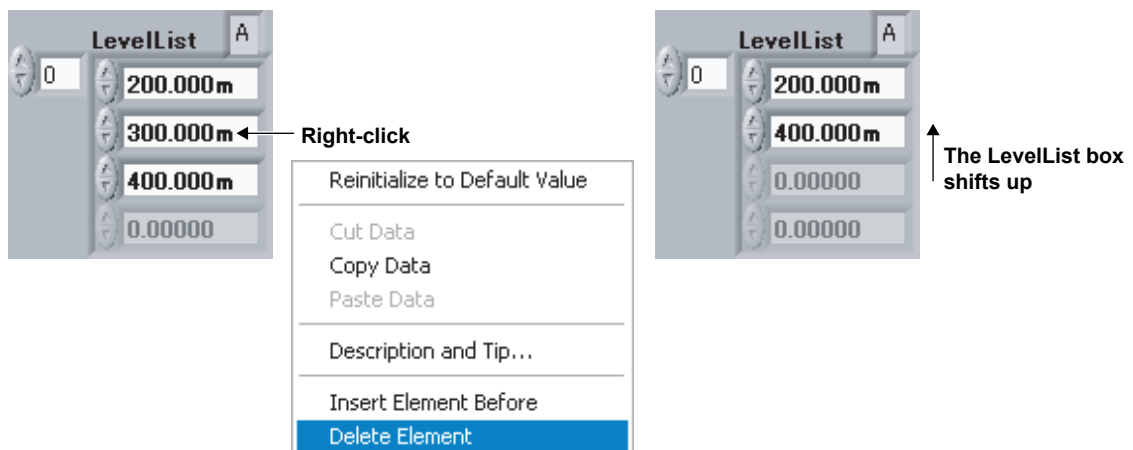
- Inserting a LevelList Value

1. Right-click the LevelList box that you want to insert a source value into.
2. Click **Insert Element Before**, and then enter a sub-channel source value.



- **Deleting a LevelList Value**

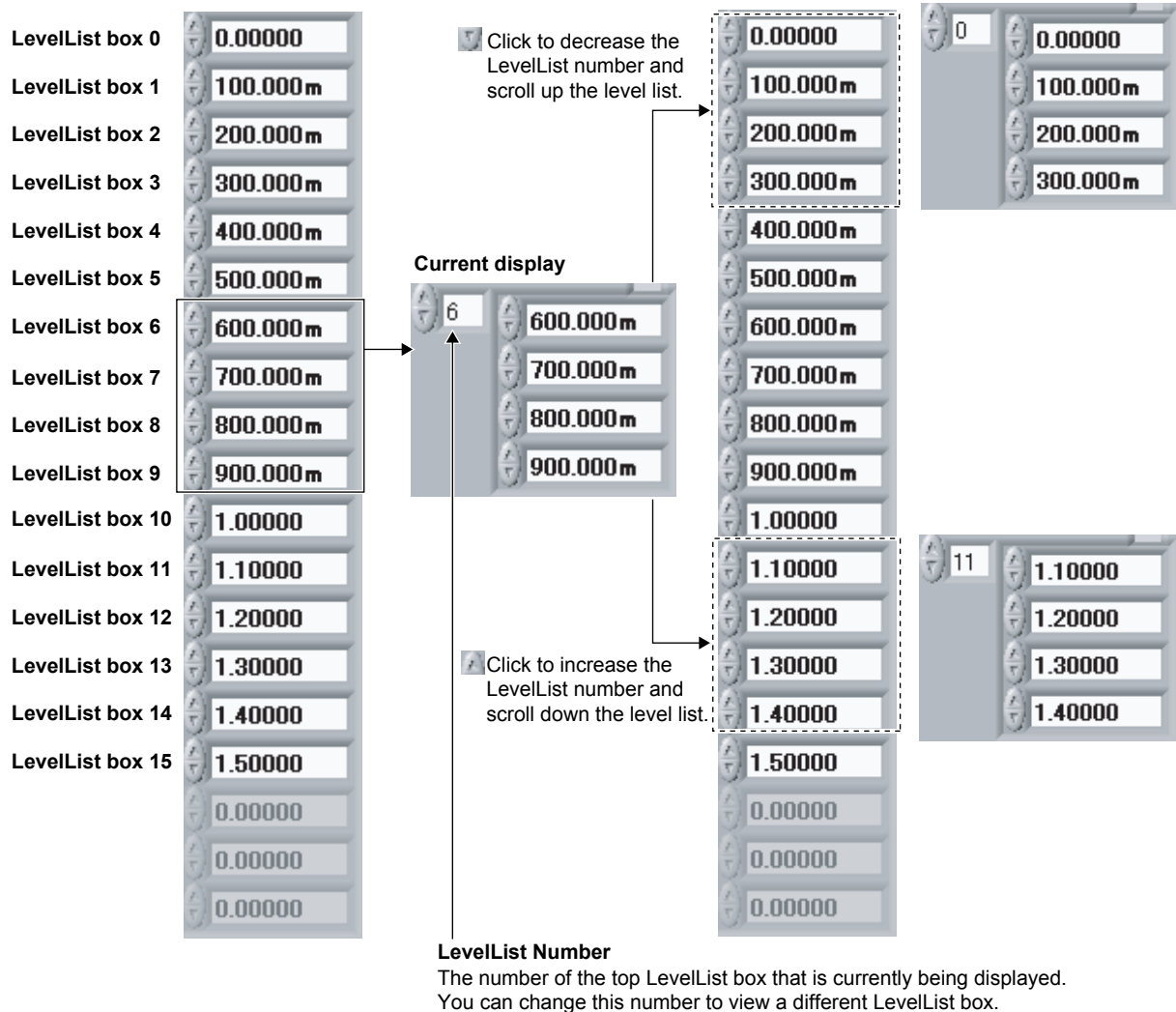
1. Right-click the LevelList box whose value you want to delete.
2. Click **Delete Element**.



### Scrolling through LevelList Boxes

You can set up to 16 LevelList values. If you set more than four LevelList values, you can click the arrow buttons next to the LevelList number box (the smaller box on the left in the LevelList area) to scroll through the boxes and view, delete, and add values.

Example for When You Have Set LevelList Values 0 to 14



### Deleting a Group of LevelList Values

As an example, the following procedure explains how to delete LevelList values 5 through 7.

1. Right-click the LevelList number box.
2. Select **Show Selection**.
3. Set the LevelList number of the first LevelList value that you want to delete.
4. Right-click the LevelList number box, and select **Start Selection**.
5. Set the LevelList number of the last LevelList value that you want to delete + 1.
6. Right-click the LevelList number box, and select **End Selection**.
7. Right-click the LevelList number box, and select **Cut Data**.

LevelList box 0: 0.00000

LevelList box 1: 100.000m

LevelList box 2: 200.000m

LevelList box 3: 300.000m

LevelList box 4: 400.000m

LevelList box 5: 500.000m

LevelList box 6: 600.000m

LevelList box 7: 700.000m

LevelList box 8: 800.000m

LevelList box 9: 900.000m

LevelList box 10: 1.00000

LevelList box 11: 1.10000

LevelList box 12: 1.20000

LevelList box 13: 1.30000

LevelList box 14: 1.40000

LevelList box 15: 1.50000

0.00000

0.00000

0.00000

→ Delete

**Specify the first box to delete.**

0: 0.00000

100.000m

200.000m

300.000m

Empty Array

Show Last Element

✓ Show Selection

Start Selection

End Selection

Select All

Show Array Element

**Specify the last box to delete.**

5: 500.000m

600.000m

700.000m

800.000m

Empty Array

Show Last Element

✓ Show Selection

Start Selection

End Selection

Select All

Show Array Element

If you scroll through the list, boxes that will be deleted are outlined in blue.

5: 500.000m

600.000m

700.000m

800.000m

**Execute the delete operation**

Reinitialize to Default Value

Cut Data

Copy Data

Paste Data

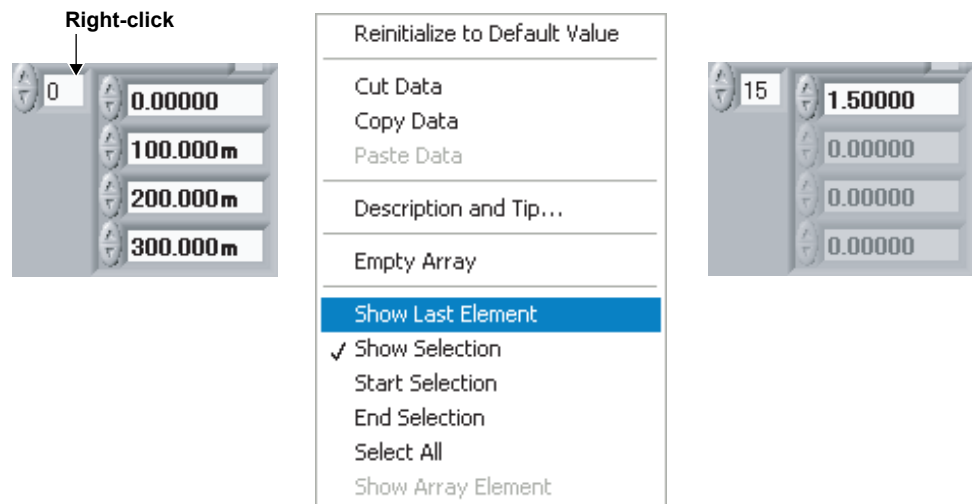
Description and Tin



### Showing the Last LevelList Value

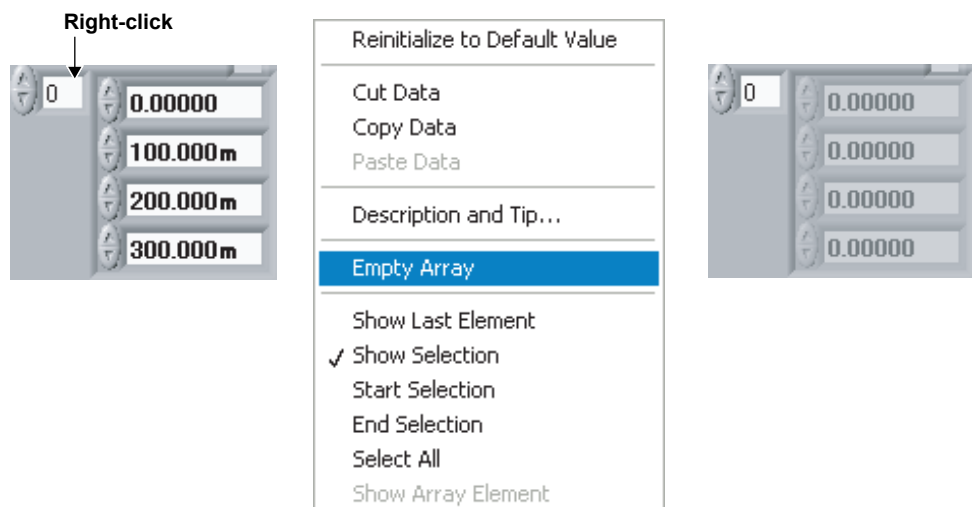
1. Right-click the LevelList number box.
2. Select **Show Last Element**.

In the case of the example on the previous page, LevelList value 14 will appear.

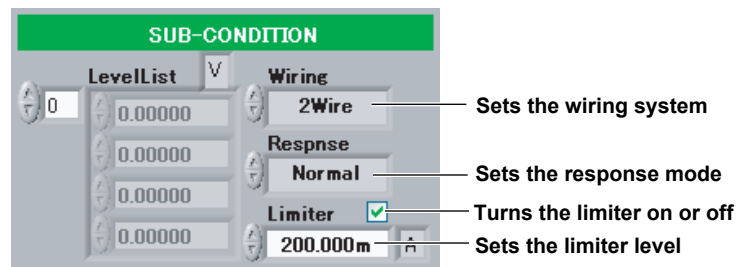


### Deleting All LevelList Values

1. Right-click the LevelList number box.
2. Select **Empty Array**.



### Other Detailed Settings



### Wiring: The Wiring System of the Sub-Channel

2Wire      A system with two wires, OUTPUT Hi and Lo.

4Wire      A system with four wires, OUTPUT Hi and Lo and SENSE Hi and Lo.

### Response: The Sub-Channel Response Mode

Normal      Normal mode

Stable      High-stability mode

When the DUT load is large and oscillation occurs, selecting Stable may improve the condition. The response is slower in stable mode, so set a large measurement delay (see section 5.4 for details).

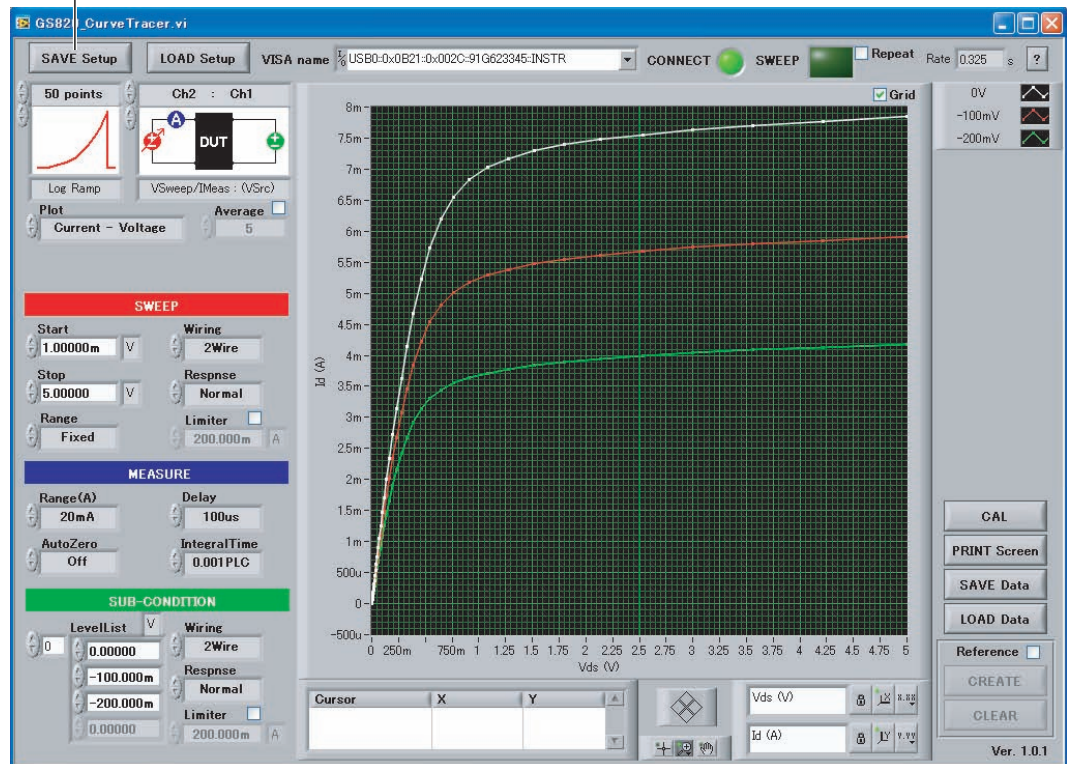
GS610\_CurveTracer does not have this setting.

### Limiter: The Sub-Channel Limiter

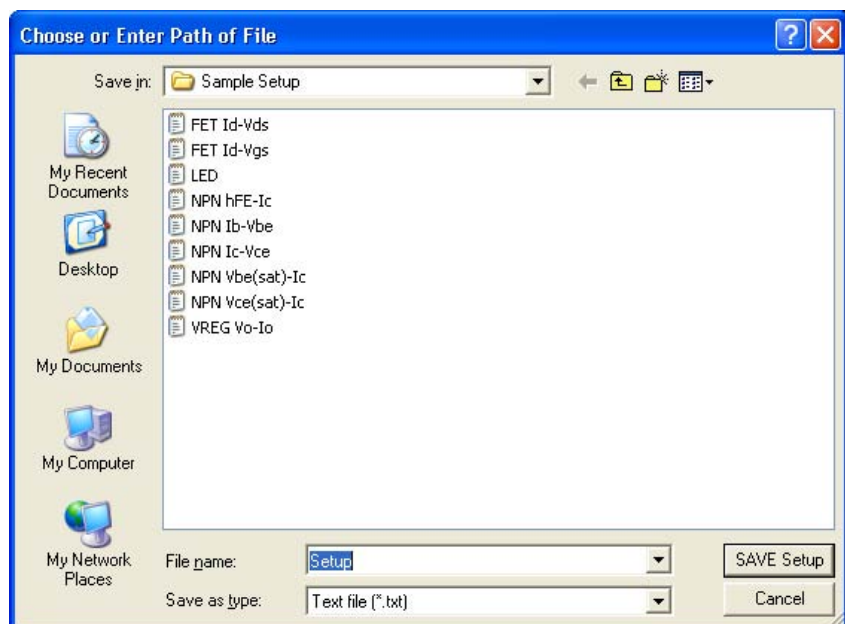
- Turning the limiter operation on and off  
Set the sub-channel limiter operation to protect the DUT.  
Off      The limiter is disabled.  
On      The limiter is enabled.
- Limiter level  
Set the upper limit for the limiter. Specify the current limit when the sub-channel in the circuit configuration is set to voltage input and specify the voltage limit when the sub-channel is set to current input. The appropriate unit appears to the right of the limit level box.

## 5.6 Saving Setup Data

Saves setup data

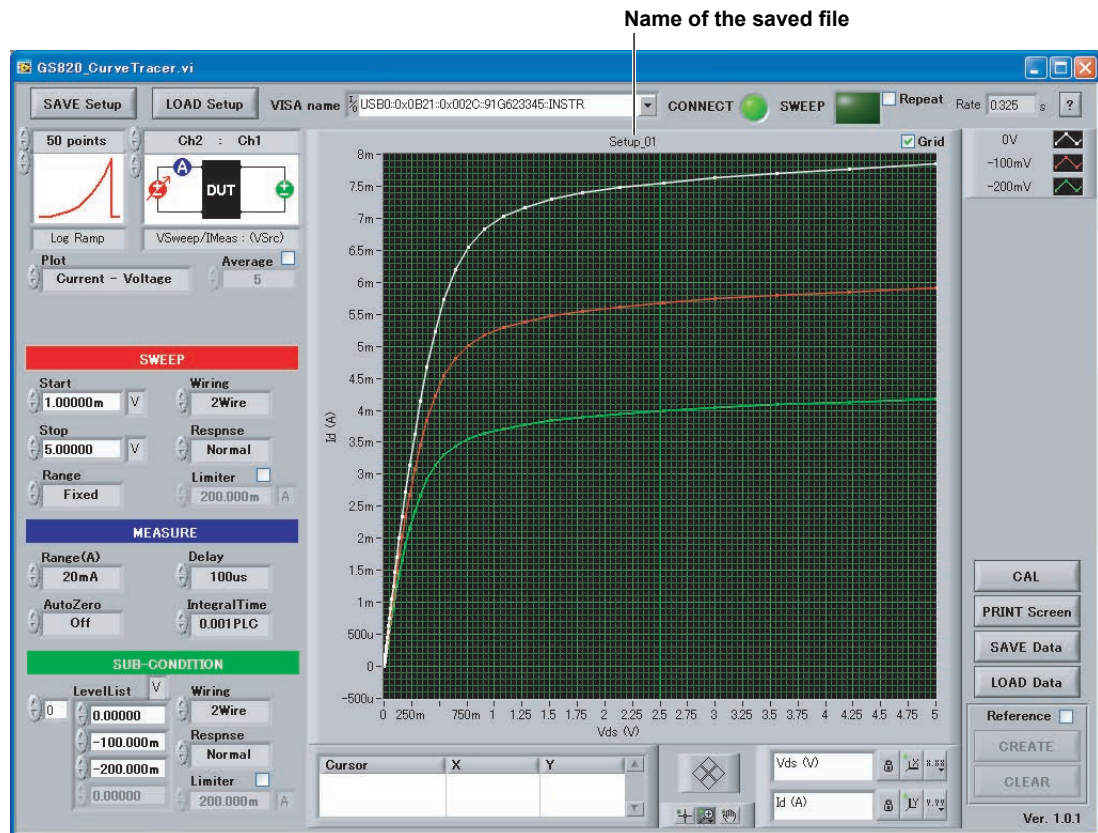


1. Click **SAVE Setup**.
2. Set the save location and the file name.
3. Click **Save Setup** to save the setup data.  
The file name extension of setup data files is .txt.



## 5.6 Saving Setup Data

The setup data save operation saves the various settings made in the setting area on the left side of the display and the cursor settings made in the lower part of the display. When you execute the setup data save operation, the name of the saved file appears at the top of the graph area.



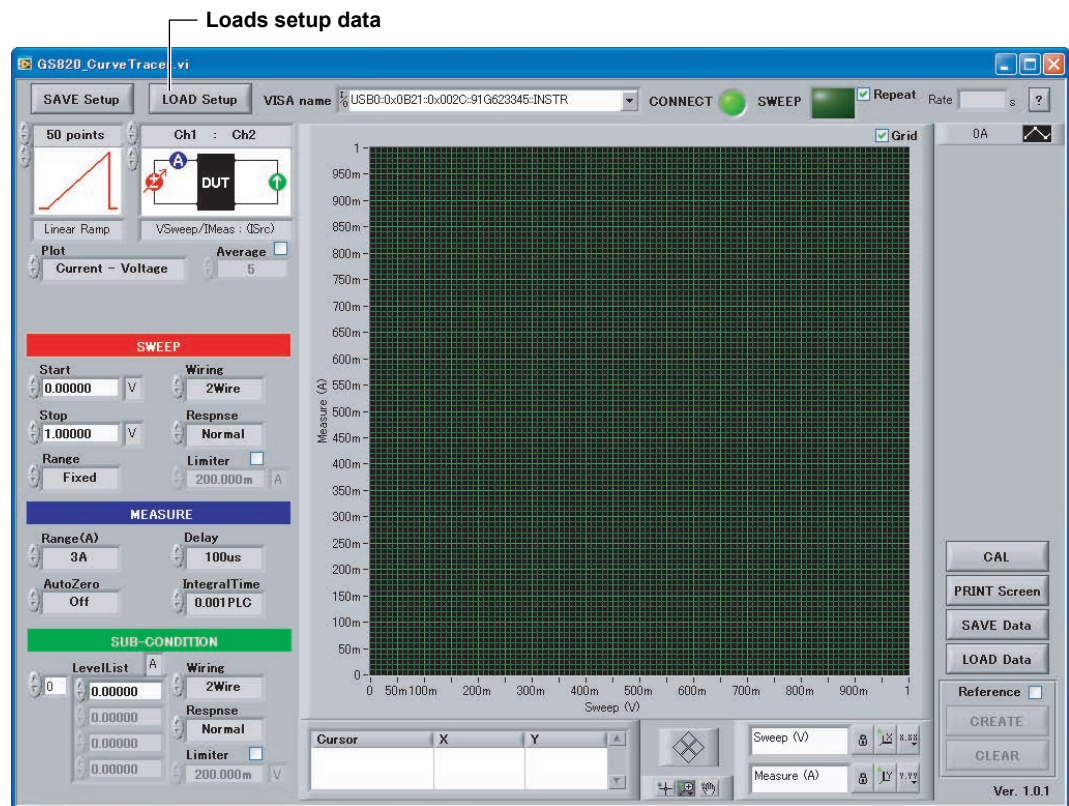
If you change one of the following settings, the saved file name will disappear from the top of the graph area.

- Circuit configuration
- Channel
- Plotted items
- Reference feature

The saved file name will not disappear from the top of the graph area if you change one of the settings not listed above (for example the sweep start level or the measurement range).



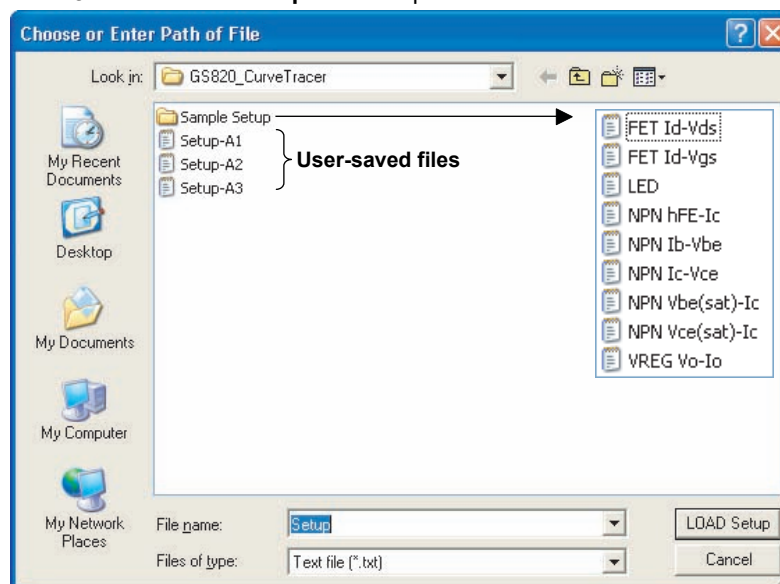
## 5.7 Loading Setup Data



You can load the setup data that you have saved using the SAVE Setup button (see section 5.6 for details). You can also load one of the sample setup files in the Sample Setup subdirectory of the installation directory (see section 2.1 for details about the installation directory).\*

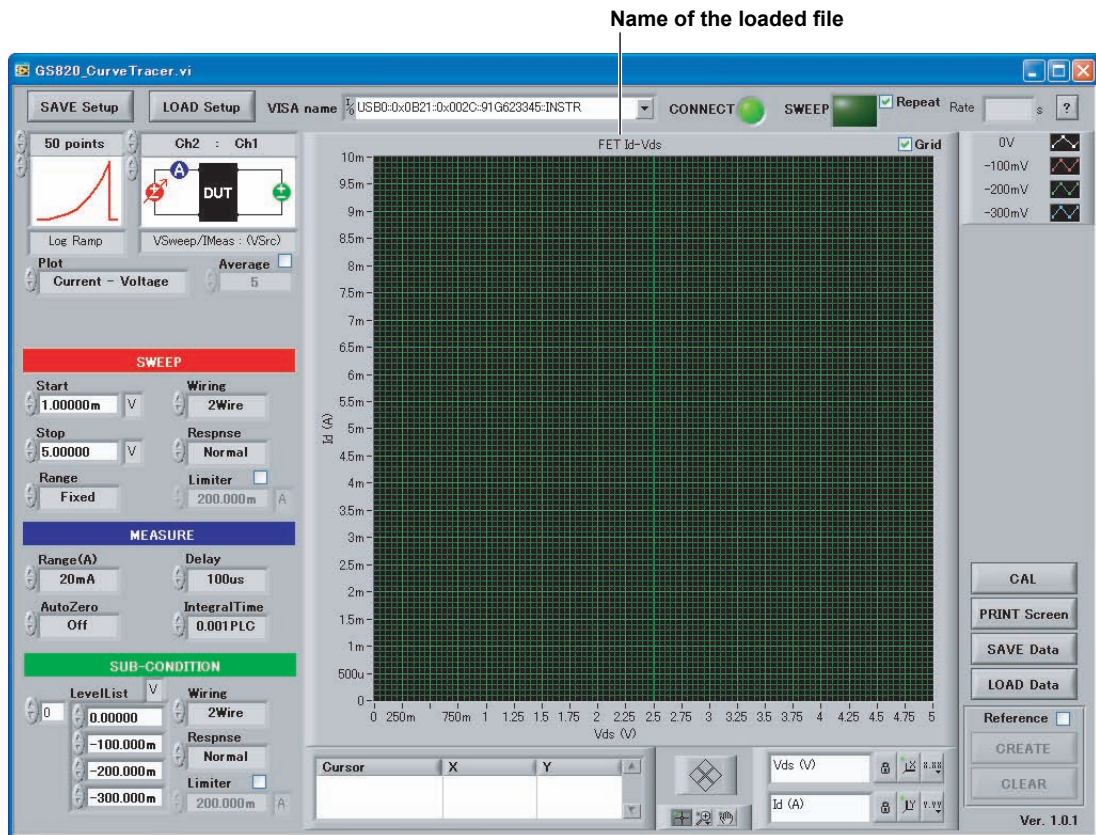
\* The default installation directory is C:\Program Files\Yokogawa\CurveTracer\.

1. Click **LOAD Setup**.
2. Specify the location and the file name of the setup file that you want to load.
3. Click **Load Setup**. The setup data is loaded.



## 5.7 Loading Setup Data

When you load setup data, the name of the setup data file that you loaded appears at the top of the graph area.



If you change one of the following settings, the loaded file name will disappear from the top of the graph area.

- Circuit configuration
- Channel
- Plotted items
- Reference feature

The loaded file name will not disappear from the top of the graph area if you change one of the settings not listed above (for example the sweep start level or the measurement range).

### Starting the Software with Custom Settings

When you start the software, various settings, such as the wiring system, are set to the initial settings configured by YOKOGAWA. To start the software with different settings, follow the procedure below.

1. Set the software to the settings that you want to start with, and save the settings by following the procedure in section 5.6.
2. Rename and move or copy the file as indicated below.  
File Name: For GS610\_CurveTracer: GS610\_default.txt  
For GS820\_CurveTracer: GS820\_default.txt  
File Location: The same directory that the software was installed in.  
(For information about the directories that GS610\_CurveTracer.exe and GS820\_CurveTracer.exe are located in, see step 5 in section 2.1.)

If you prepare a custom setup file, as soon as you click the CONNECT button and the PC connects to the GS, the setup file is loaded, and the settings are changed accordingly. Therefore, if the software automatically connects to the GS when it starts, the various settings will automatically be set to the custom settings. If you always use the software with the same setting configuration, you can save yourself the trouble of having to reconfigure the settings whenever you start the software. You can also avoid the danger of applying unwanted voltage or current to the device under measurement by accidentally clicking SWEEP before you have loaded a custom file.

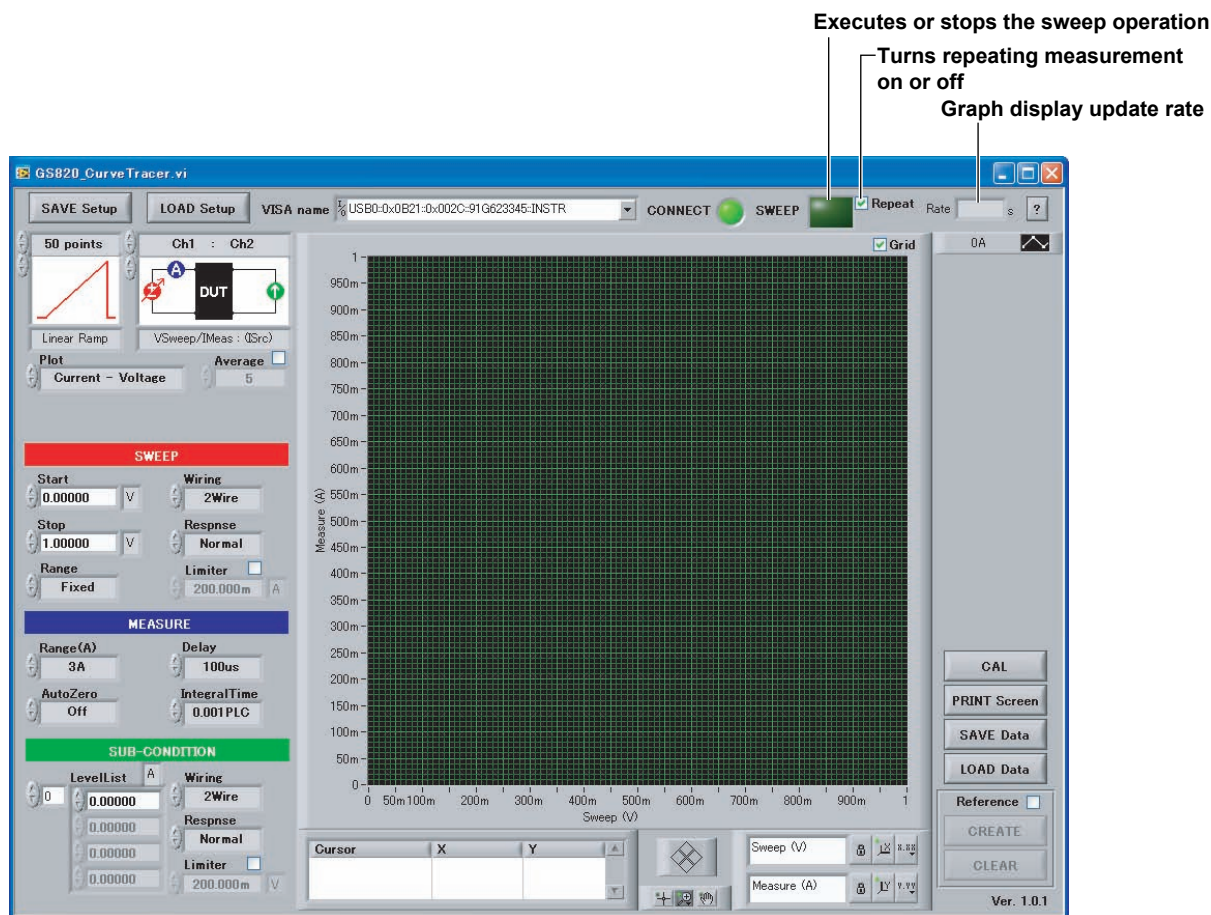
---

**Note**

The software will start using the initial settings configured by YOKOGAWA if it is unable to automatically connect to the GS. This can occur if:

- The USB cable is not connected.
  - The GS power is off.
  - The USB interface mode is set to Storage.
  - The number of GS610s that the PC can connect to is three or greater. The number of GS820s that the PC can connect to is two or greater.
-

## 6.1 Starting and Stopping the Sweep Operation



6

Executing the Sweep Operation

### Starting the Sweep Operation

Click SWEEP. Sweeping begins, and the SWEEP button lights. If repeating measurement is off, a graph is drawn after a single sweep finishes. When the sweep finishes, the sweep operation automatically stops, and the SWEEP button light turns off.



### Stopping the Sweep Operation

Click SWEEP while the sweep operation is in progress. The sweep operation stops, and the SWEEP button light turns off.



### Rate: The Graph Display Update Rate

The graph display update rate is the time from the start of a sweep to the display of its corresponding graph. The update rate is updated each time the graph is drawn. When repeating measurement is on, the graph display update rate is the time between the previous graph display and the current graph display.



## 6.1 Starting and Stopping the Sweep Operation

### Repeat: Repeating Measurement

Off: One sweep is performed, and then the sweep operation stops.

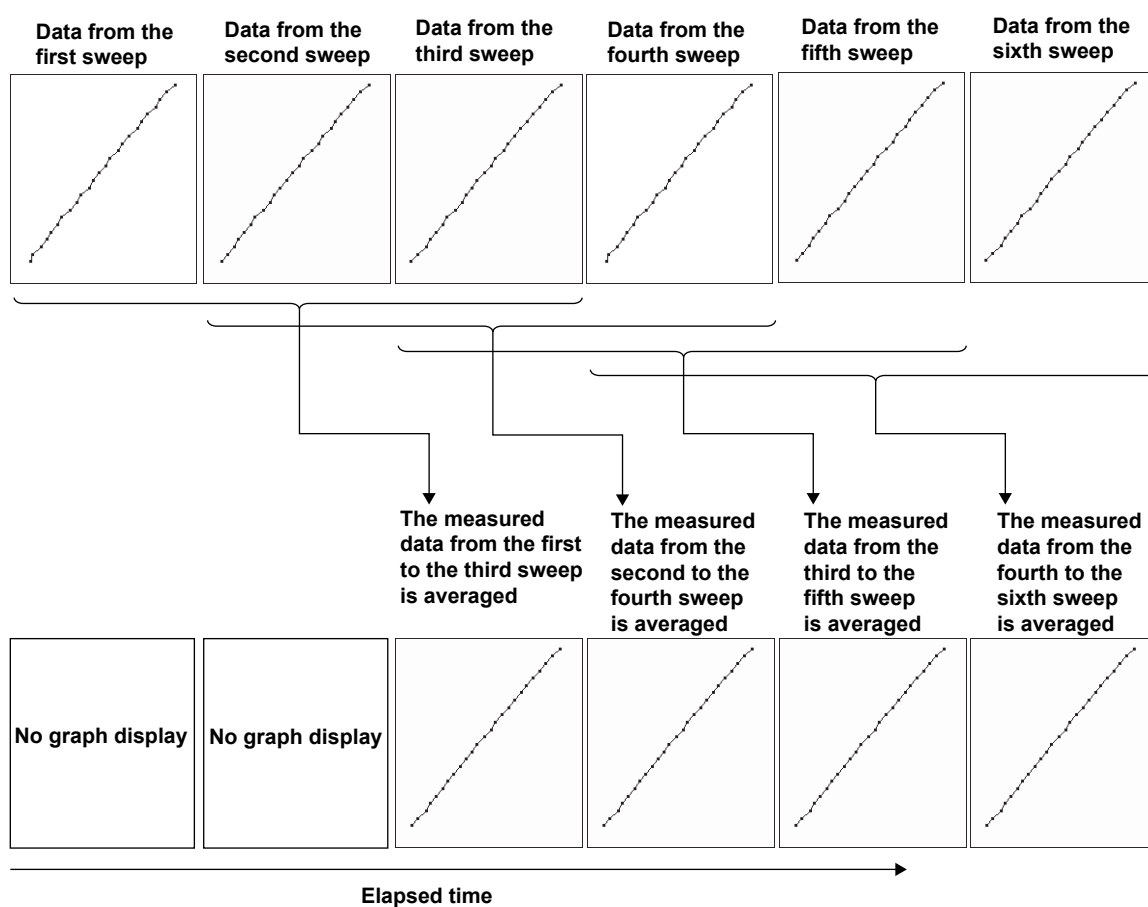
On: Sweeps are repeated.

When Average (graph averaging; see section 5.2 for details) is on, repeating measurement functions in the way described below.

Example for When the Number of Averaged Values Is Three

Off: Three sweeps are performed, the averaged graph is displayed, and then the sweep operation finishes.

On: An averaged graph is displayed after three sweeps have been performed. Afterwards, the graph is updated after every sweep using the averaged values of the most recent three sweeps. This operation continues until you click SWEEP to stop the sweep operation.



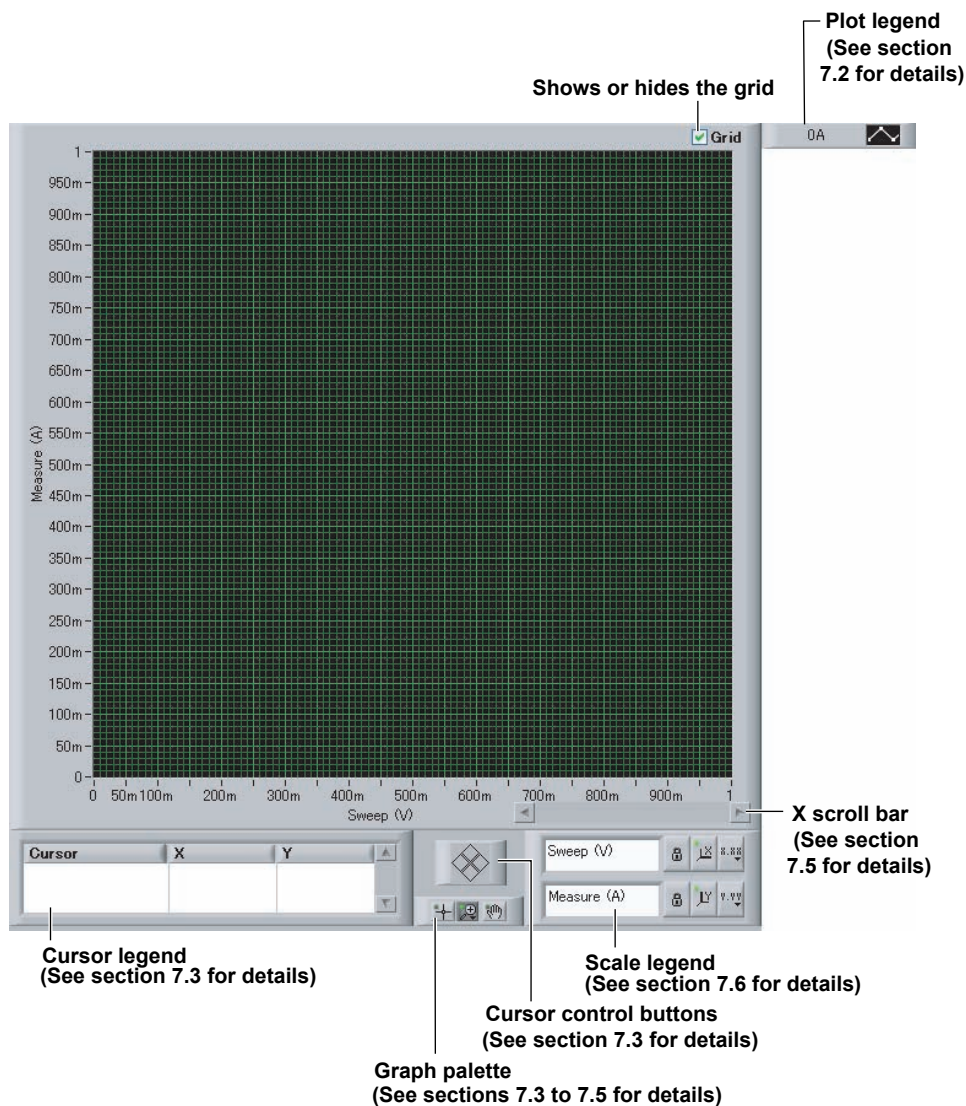
### Changing Settings during the Sweep Operation

You can change the sweep settings that you configured in chapter 5 while the sweep operation is in progress. However, the sweep operation will stop if you:

- Change the VISA name (see section 4.1 for details).
- Change the channel settings (see section 5.2 for details).
- Change the circuit configuration (see section 5.2 for details).
- Load setup data (see section 5.7 for details).
- Turn the reference feature on or off (see section 7.8 for details).

## 7.1 Graph Setting Boxes and Buttons

Use the boxes and buttons shown below to configure graph settings. You can turn the display of graph-related boxes and buttons on and off.



### Note

- The X scroll bar is hidden by default.
- The Grid check box (which shows or hides the grid) is always displayed.

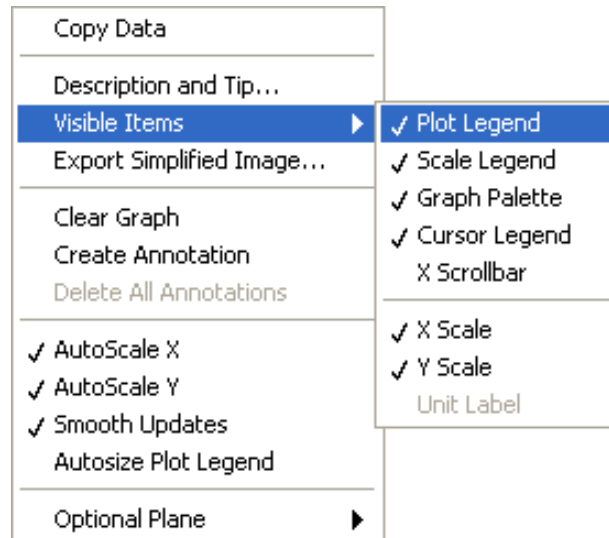
### Showing and Hiding Graph-Related Boxes and Buttons

1. Right-click the graph display area.
2. Point to **Visible Items**.
3. Select or unselect the appropriate items.

#### **Note**

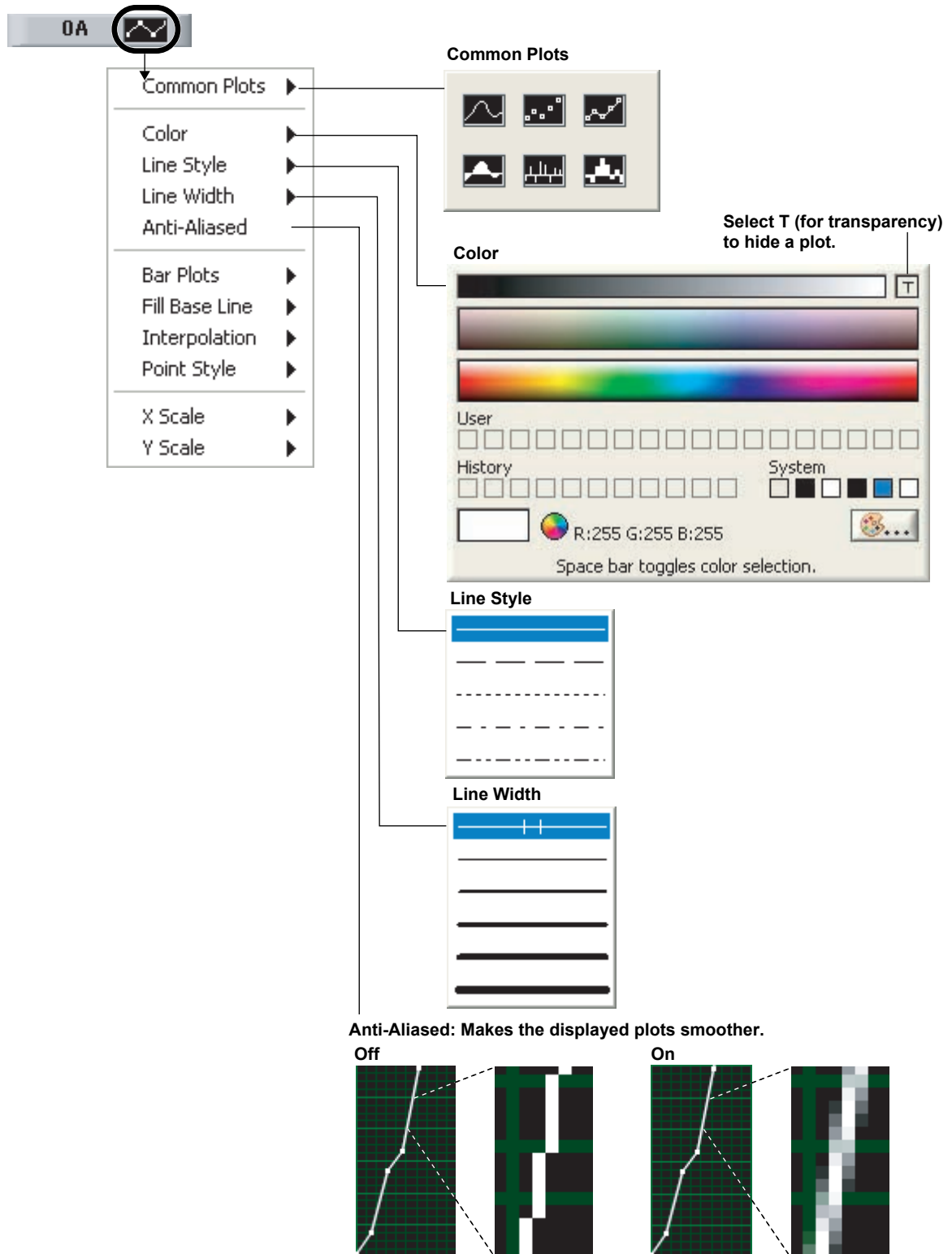
The cursor legend and the cursor control buttons are shown and hidden together.

---

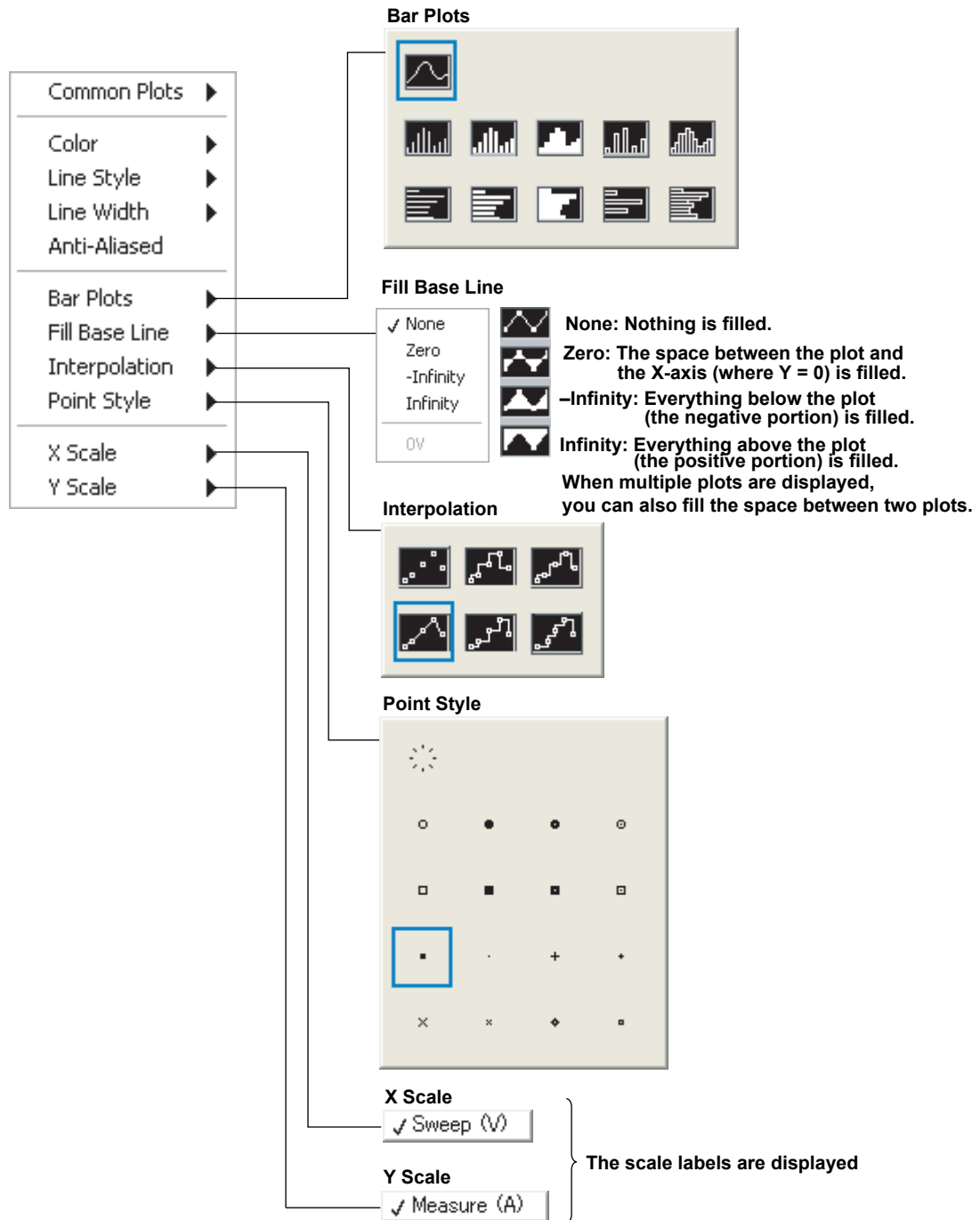


## 7.2 Configuring the Plot Display Format

1. Click the plot legend
2. Configure the plot display format settings.

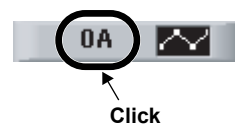


## 7.2 Configuring the Plot Display Format



### Setting the Plot Legend Label

Click the plot legend label, and edit its text.



The plot legend label will return to its default value if you change any of the following settings:

- Circuit configuration (see section 5.2 for details)
- Plotted items (see section 5.2 for details)
- Reference feature (see section 7.8 for details)

## 7.3 Configuring the Cursors

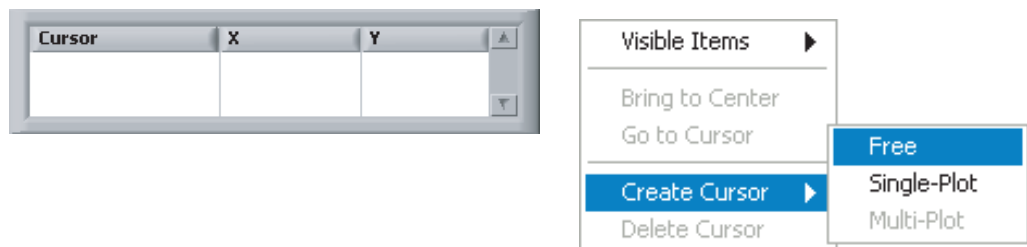
By configuring the cursors, you can check the plotted coordinates (measured values).

### Creating a Cursor

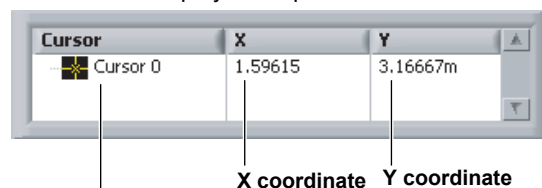
1. Right-click the cursor legend
2. Point to **Create Cursor**.
3. Click Free or Single-Plot.
  - Free: You can move the cursor anywhere in the display regardless of the plots in the graph display.
  - Single-Plot: The cursor moves along a single plot in the graph display.

### Note

You cannot select Multi-Plot.



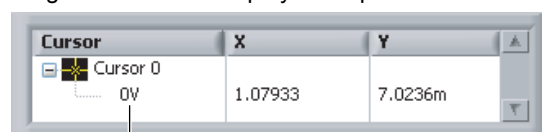
### Free Cursor Display Example



#### Cursor name

You can set the cursor name as you please.

### Single-Plot Cursor Display Example



The name of the plot that the cursor is snapped to.

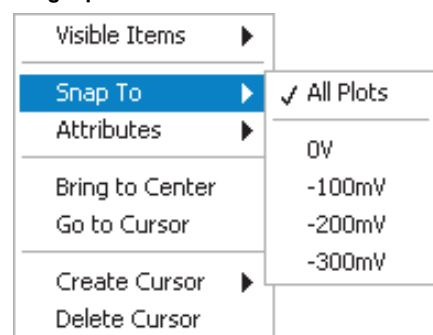
### Changing the Plot That the Cursor Moves Along

You can change the plot that a single-plot cursor moves along.

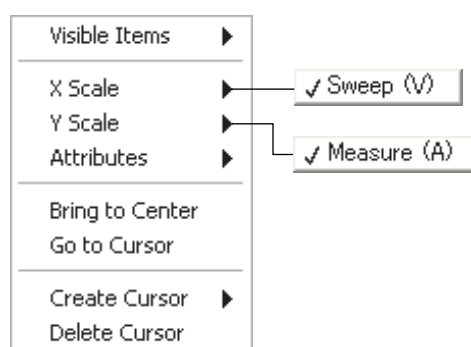
1. In the cursor legend, right-click the cursor whose plot you want to change.
2. Point to **Snap To**.
3. Click the plot that you want the cursor to move along.

You cannot select a plot for a free cursor to move along. If you right-click a free cursor in the cursor legend, X Scale and Y Scale appear instead of Snap To. Clicking these options will display their corresponding scale labels.

#### Single-plot cursor

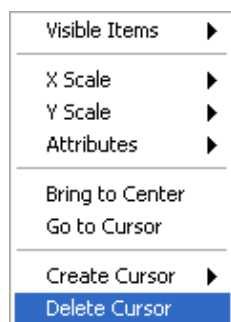


#### Free cursor



### Deleting a Cursor

1. In the cursor legend, right-click the cursor that you want to delete.
2. Click **Delete Cursor**.



### Measuring with Cursors

When two or more cursors are displayed, the following information about two of the displayed cursors appears at the top of the graph display area.

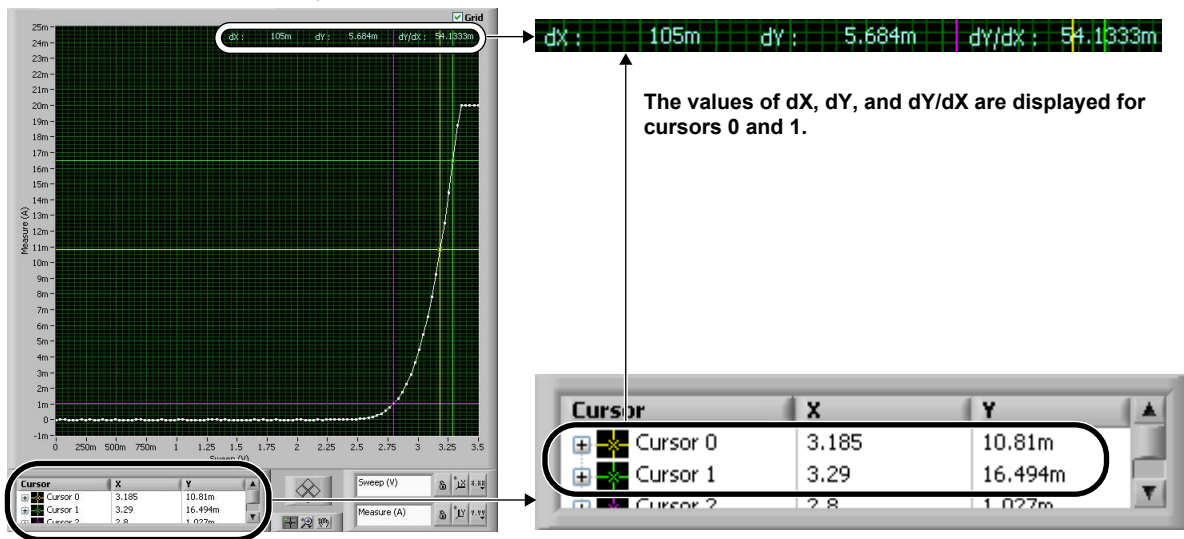
- dX: The difference between the X coordinates of the cursors.
- dY: The difference between the Y coordinates of the cursors.
- dY/dX: The slope between the cursors.

dX and dY are computed for the top two cursors in the cursor legend. The values of the second cursor are subtracted from the values of the top cursor.

#### Note

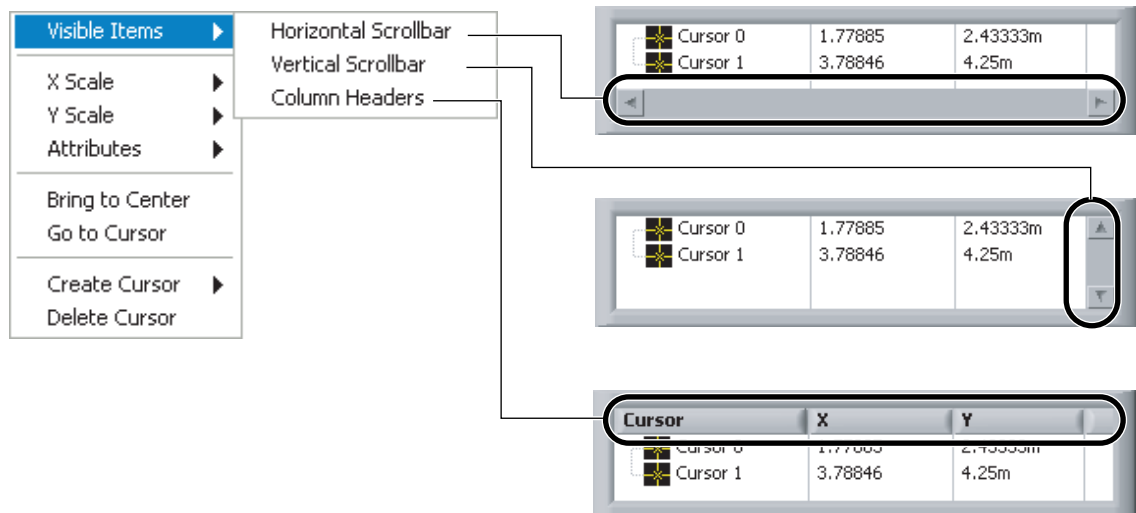
If you create or delete cursors while sweeping is stopped, the values listed above will be updated after the cursors are moved or sweeping starts.

Display with Three Cursors



### Configuring the Cursor Legend Display Format

1. Right-click the cursor legend.
2. Point to **Visible Items**.
3. Select or unselect the appropriate items.



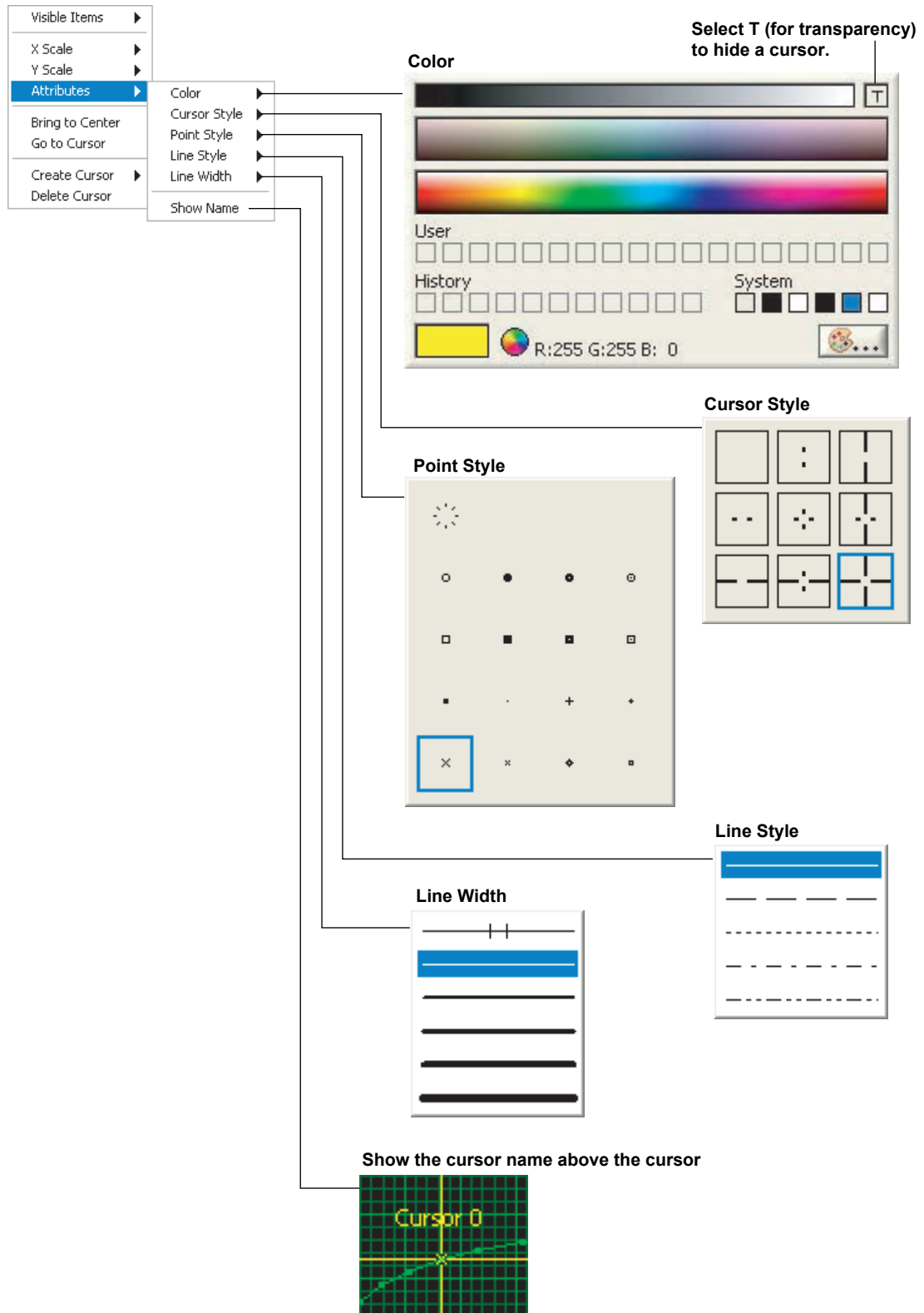
### Note

Do not unselect Column Headers. Even if you unselect Column Headers, a portion of the column headers continues to be displayed, and this portion will overlap the cursor list display.



### Configuring the Cursor Display Format

1. In the cursor legend, right-click the cursor that you want to configure the format of.
2. Point to **Attributes**.
3. Configure the various settings.



### Saving and Loading Cursor Settings

When you save setup data (see section 5.6 for details), the various settings in the setting area and the cursor settings are saved.

You can load these settings by loading the setup data (see section 5.7 for details).

### Moving Cursors

The three ways that you can move cursors are described below.

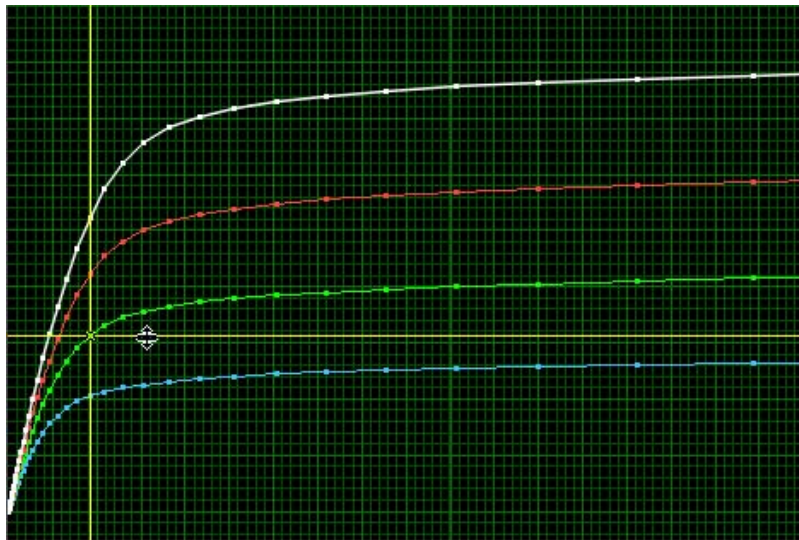
- **Dragging a Cursor on the Graph Display**

1. Click the **mouse movement** button on the graph palette.



Mouse movement

2. Move the cursor by dragging it.



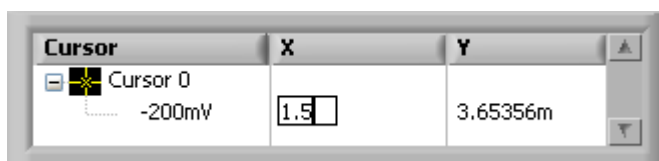
- **Using the Cursor Control Buttons**

1. In the cursor legend, click the cursor that you want to move.
2. Move the cursor by clicking the cursor control buttons.



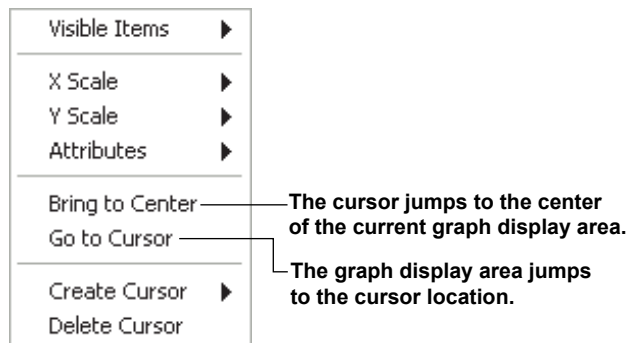
- **Specifying the Cursor Coordinates**

1. In the cursor legend, click the cursor coordinate that you want to specify.
2. Specify the coordinate.



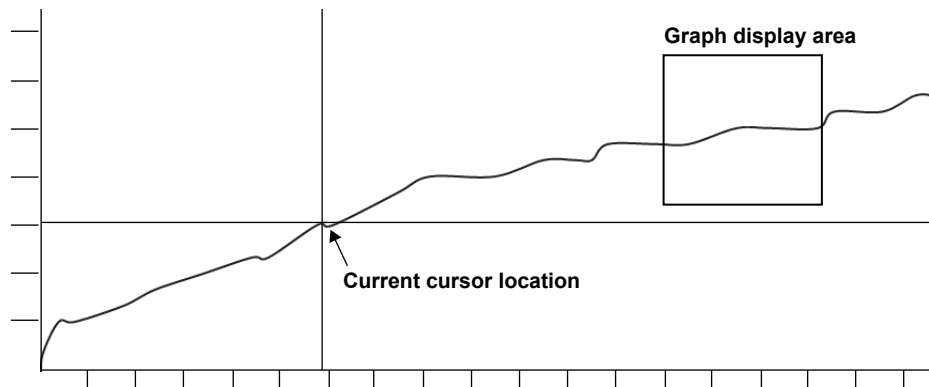
### Cursor Jumping

1. In the cursor legend, right-click the cursor that you want to use to jump.
2. Select a jump method.

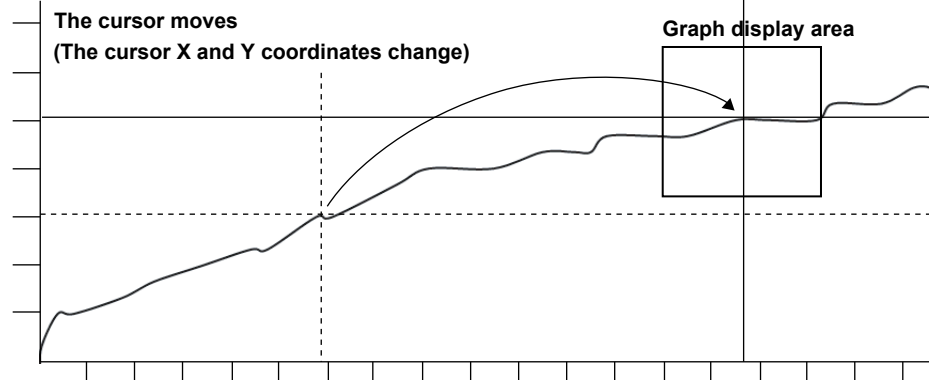


The cursor and the graph display area move as illustrated below.

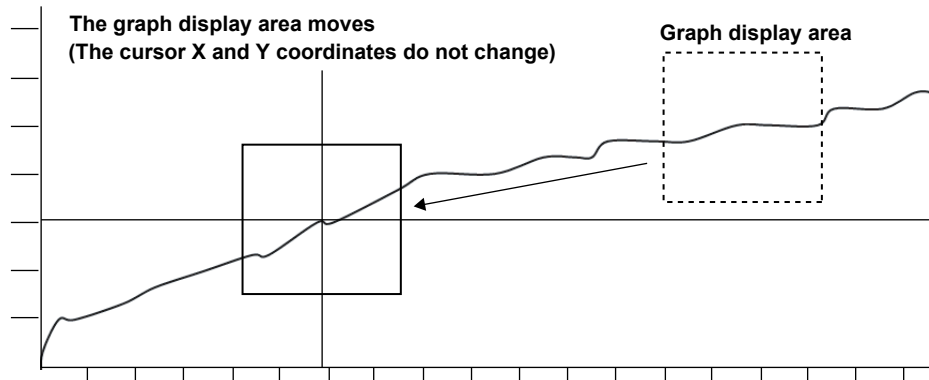
#### Current cursor location and graph display area



#### Bring to Center



#### Go to Cursor



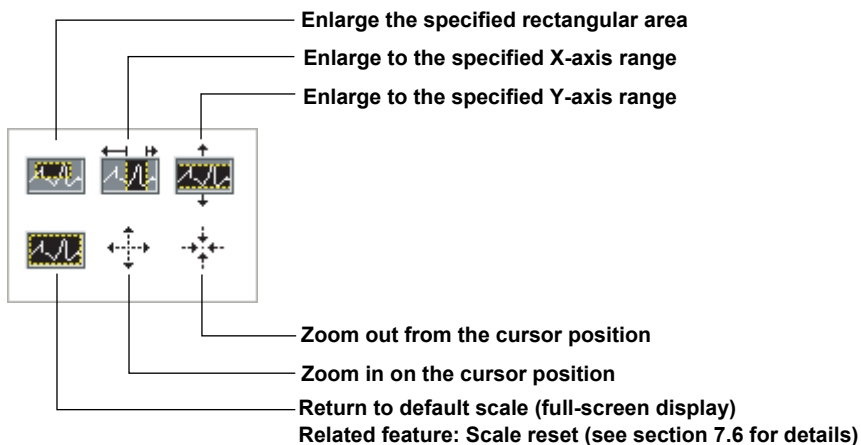
## 7.4 Scaling the Graph Display

1. Click the graph scaling button on the graph palette.



Graph scaling

2. Select the graph scaling method.



3. Click or drag the mouse in the graph display area to scale the graph display.

### **Note**

If auto scaling is on (see section 7.6 for details), the scale will be optimized when the sweep operation finishes or when measured data is loaded (see section 8.4 for details).

## 7.5 Scrolling the Graph Display

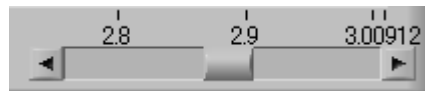
### Scrolling by Dragging the Mouse

1. Click the **grab** button on the graph palette.

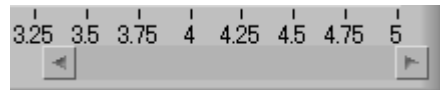


### Scrolling by Using the Scroll Bar (along the X-axis)

1. Display the X scroll bar according the procedure described in section 7.1.
2. Scroll through the graph display by dragging the scroll bar.



When the graph display is set to default scale (full-screen display), the X scroll bar cannot be used to scroll, and it appears as shown below.



### **Note**

If auto scaling is on (see section 7.6 for details), the scale will be optimized when the sweep operation finishes or when measured data is loaded (see section 8.4 for details).

## 7.6 Setting the X-Axis and Y-Axis Scales

**Scale Legend**

X-axis label: Sweep (V)

Y-axis label: Measure (A)

Auto scale lock button

Auto scale

Manual scale

These buttons correspond to the AutoScale X and AutoScale Y menu items in the menu that appears when you right-click the graph display area.

✓ AutoScale X

✓ AutoScale Y

**Reset button**  
Returns to the default scale (full-screen display)  
Related feature: Graph scaling (see section 7.4 for details)

**Parameter button**

Format

Precision

Mapping Mode

✓ Visible Scale

✓ Visible Scale Label

Grid Color

**Format**

Decimal

Scientific

Engineering

Binary

Octal

Hexadecimal

Relative Time

Absolute Time

✓ SI

**Precision**

0

1

2

3

4

5

✓ 6

**Mapping Mode**

✓ Linear

Logarithmic

**Visible Scale**  
Shows or hides the X and Y axis scale labels.

**Visible Scale Label**  
Shows or hides the X and Y axis scale labels. If the scales are hidden, the scale labels are also hidden.

**Grid Color**

If you want to hide the X or Y axis, select T (for transparency). To hide or show the entire grid, use the Grid check box at the top of the graph display area.

User

History

System

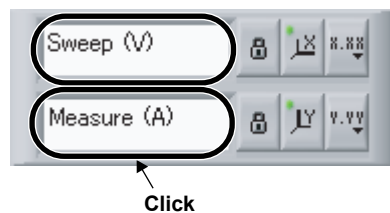
R: 0 G: 80 B: 0

Space bar toggles color selection.

## 7.6 Setting the X-Axis and Y-Axis Scales

### Setting the Scale Labels

Click a scale label, and edit its text. The graph axis name will change accordingly.



The scale label will return to its default value if you change any of the following settings.

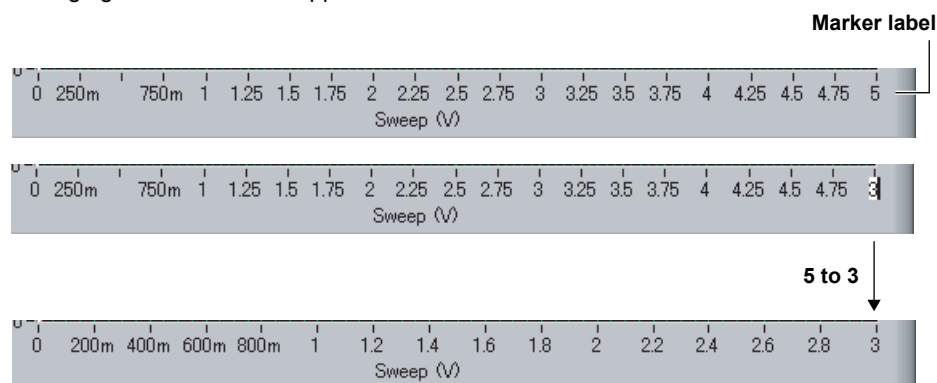
- Circuit configuration (see section 5.2 for details)
- Plotted items (see section 5.2 for details)

### Setting the Scales

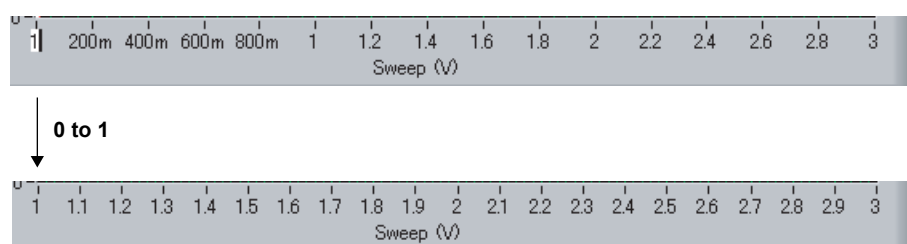
Set the marker labels at each end of the coordinate axis. The scale will change based on the values you specify.

Example

Changing the X-axis scale upper limit from 5 to 3 V



Changing the X-axis scale upper limit from 0 to 1 V



### Setting the Marker Spacing

1. Right-click an X-axis marker or marker label.
2. Point to **Marker Spacing**.
3. Select Uniform or Arbitrary.

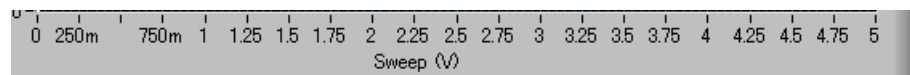
Uniform: The marker spacing is set automatically.

Arbitrary: You can set the spacing between each marker.

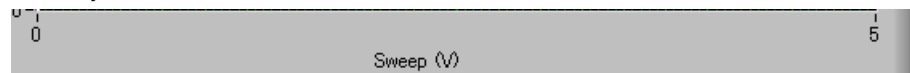


If you select arbitrary spacing, markers will only be displayed at each end of the coordinate axis. You can add markers by following the procedure described below:

#### Uniform



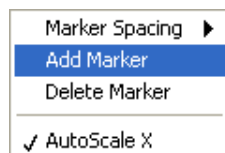
#### Arbitrary



### Adding a Marker

You can add a marker in one of these two ways:

- Drag a marker at either end of the coordinate axis horizontally. A new marker is added.
- Right-click a marker or marker label, and click **Add Marker**. A new marker appears on top of the old marker. You can move the new marker in one of the ways listed below.



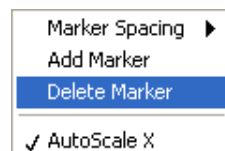
### Moving a Marker

You can move a marker in one of these two ways:

- Drag the marker.
- Change the marker label value. The marker moves to the location that corresponds to the value that you set.

### Deleting a Marker

Right-click the marker or marker label that you want to delete, and click **Delete Marker**.



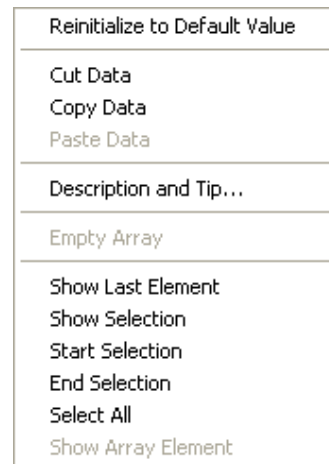


## 7.6 Setting the X-Axis and Y-Axis Scales

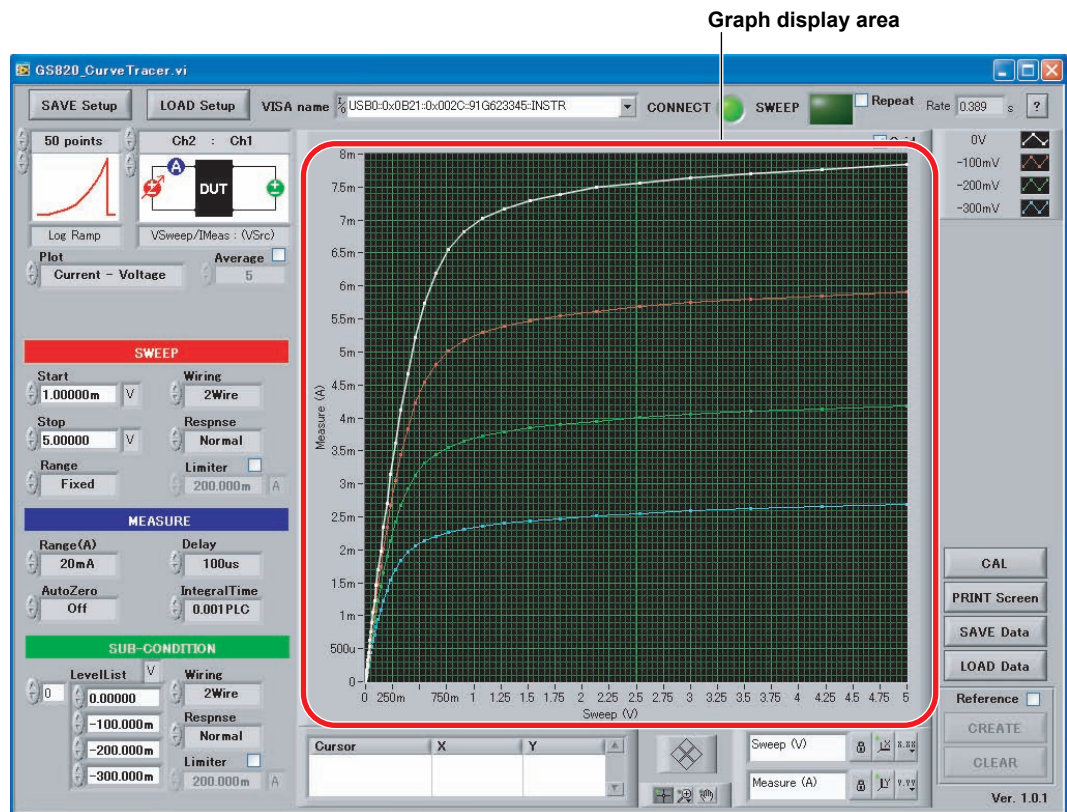
---

### Other Display Items

The menu that appears when you right-click the scale legend (shown below) is not used in this software.

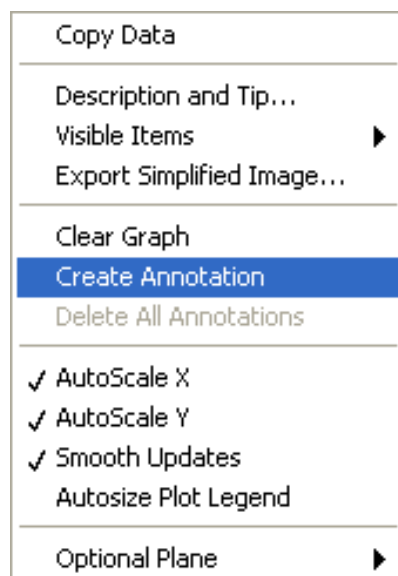


## 7.7 Creating and Deleting Annotations



### Creating Annotations

1. Right-click the graph display area.
2. Click **Create Annotation**.
3. Configure these settings: **Annotation Name**, **Lock Style**, **Locked Plot**, **Hide Arrow**, and **Lock Name**.



## 7.7 Creating and Deleting Annotations

### Annotation Name

You can enter double-byte or single-byte characters.

### Lock Style

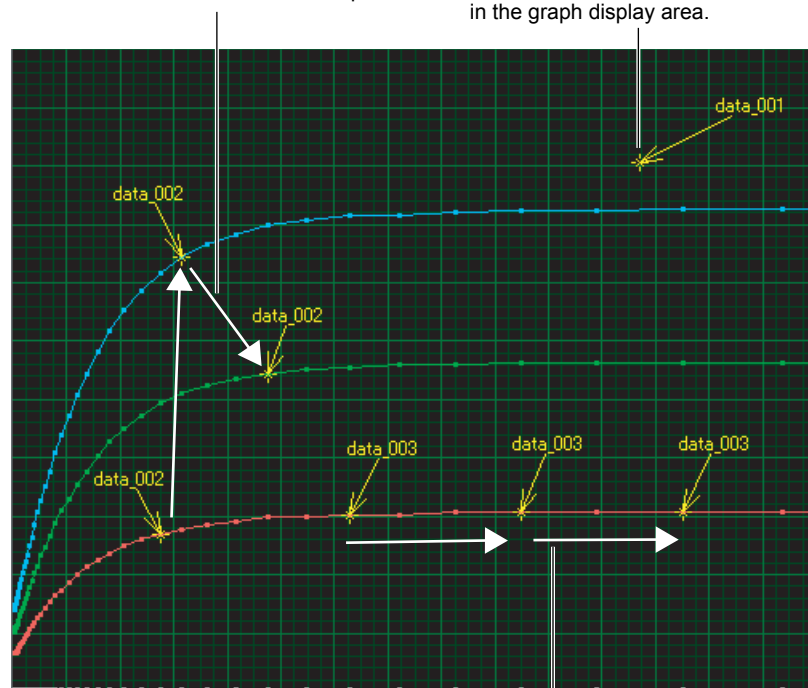
- Free  
You can place the annotation anywhere in the graph display area.
- Snap to all Plots  
When multiple plots are shown in the graph display, you can snap the annotation to any plot.
- Snap to One Plot  
When multiple plots are shown in the graph display, you can select which plot to snap the annotation to from the Locked Plot box.

#### Snap to all Plots

You can move the annotation on all plots.

#### Free

You can move the annotation anywhere in the graph display area.



#### Snap to One Plot

You can move the annotation on a single plot.

**Locked Plot**

If you set the Lock Style to ???, use this box to select which plot to snap the annotation to.

**Hide Arrow**

Off (show arrow)



On (hide arrow)



**Lock Name**

Choose whether or not to specify where the annotation name is displayed.

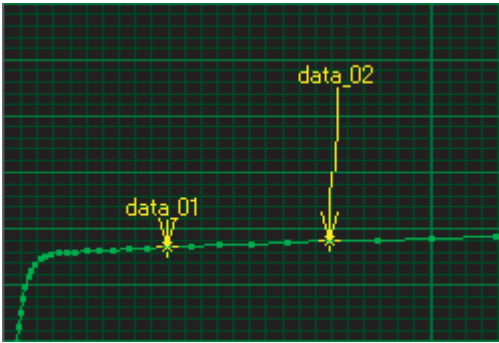
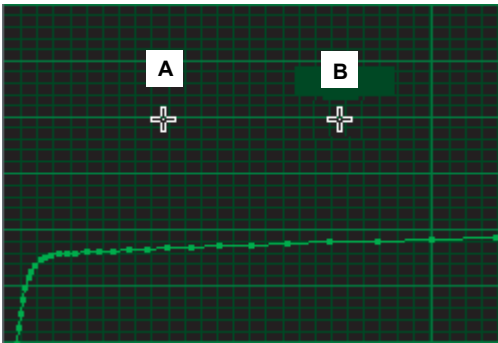
On: The annotation name appears where you right-clicked (in step 1).

Off: The annotation name will appear above the annotation.

Example: Right-click on points A and B and create annotations on the plot.

A: Lock Name is disabled.

B: Lock Name is enabled.

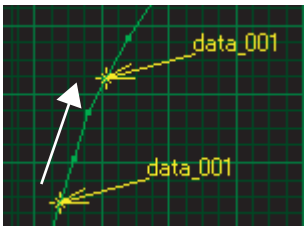


Even when Lock Name is enabled, you can move the annotation name.  
When Lock Name is enabled, the annotation name will not move when you move the annotation.

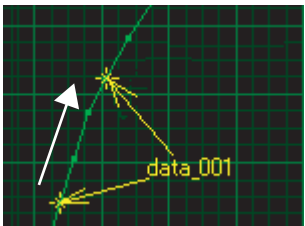
**Moving an Annotation**

Drag the annotation to move it.

When Lock Name is disabled



When Lock Name is enabled



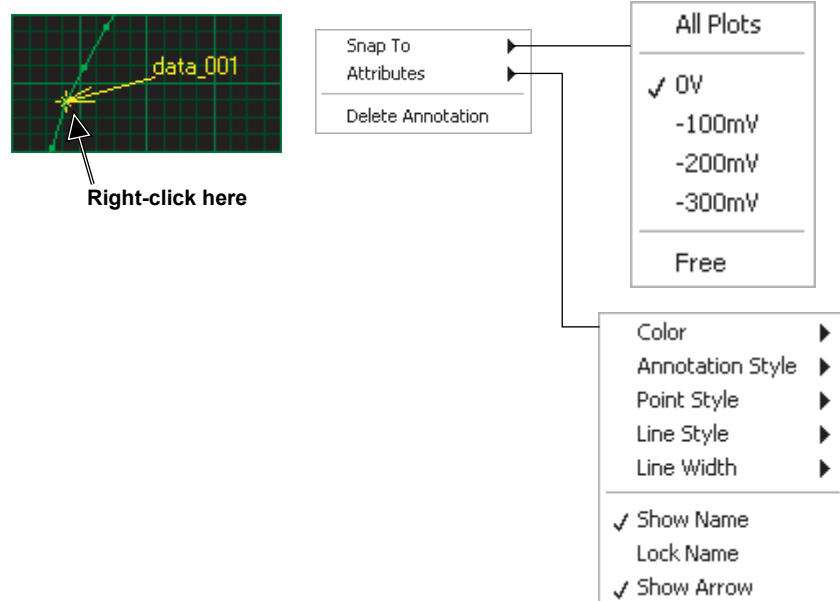
**Moving an Annotation Name**

Drag the annotation name to move it.



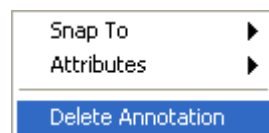
### Changing an Annotation's Attributes and the Graph That It Snaps To

1. Right-click the annotation.
2. Select the item that you want to change.



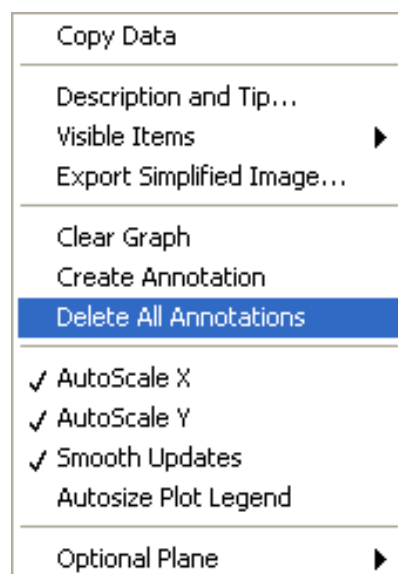
### Deleting an Annotation

1. Right-click the annotation.
2. Click **Delete Annotation**.



### Deleting All Annotations

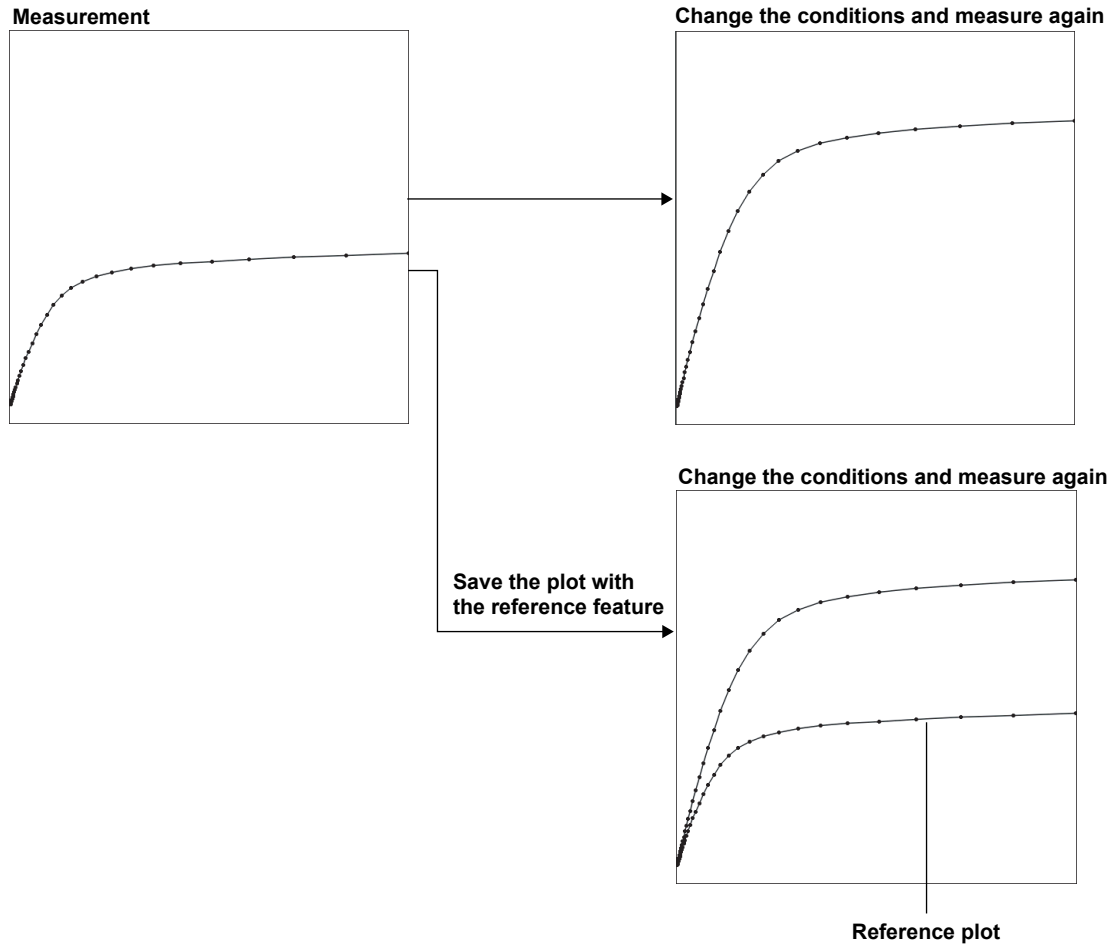
1. Right-click the graph display area.
2. Click **Delete All Annotations**.



## 7.8 Using the Reference Feature

### What the Reference Feature Does

Each time a sweep operation is executed, the plot from the previous sweep disappears. You can use the reference feature to retain the plot from a previous sweep as a reference plot. You can re-execute a sweep and compare the new plot with the reference plot. As with measured data plots, you can measure reference plots with cursors, scale them, and save their measured data.



### Reference Feature vs. the Sub-Channel Level List

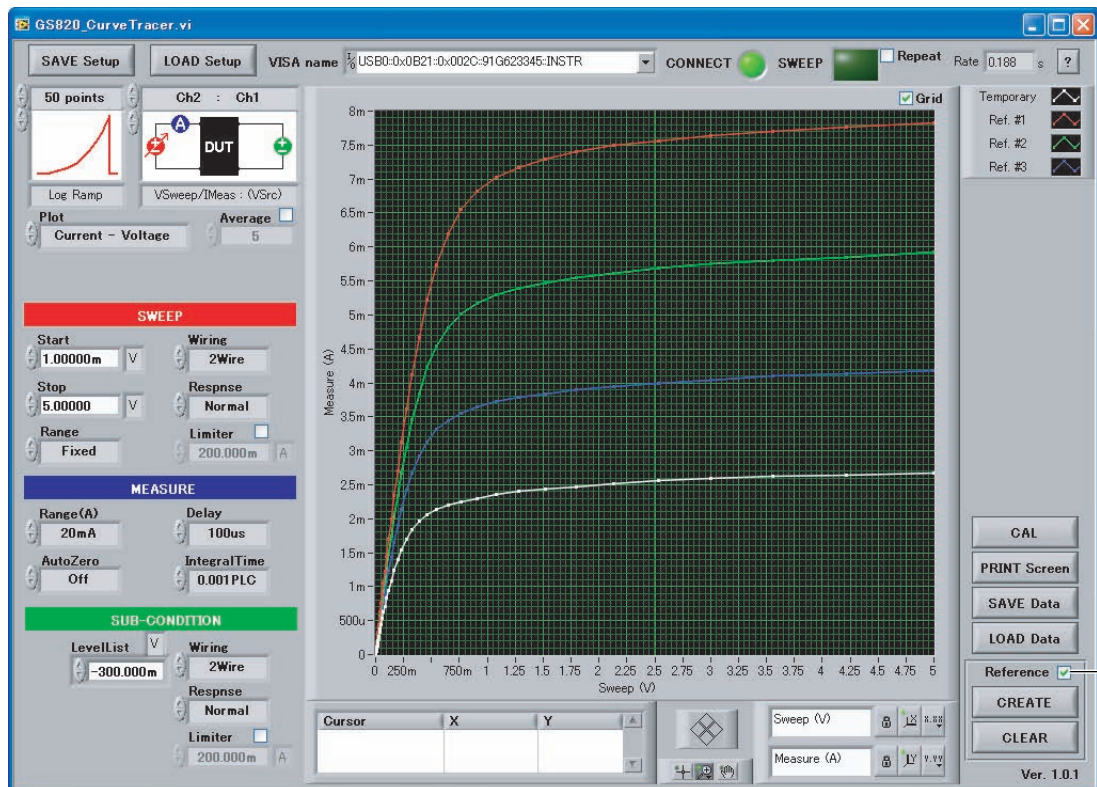
Like the reference feature, the sub-channel level list allows you to display multiple plots (see section 5.5 for details). You can use either of the following methods to change sub-channel source values and repeat measurement.

- Use the level list to measure using multiple sub-channel source values.
- Change the sub-channel source value each time you measure, and use the reference feature to retain previous plots.

The reference feature is useful when you want to compare measurements by changing conditions that cannot be handled by the level list. For example, you can:

- Make different measurements while changing the DUT temperature and compare those measurements.

## 7.8 Using the Reference Feature



Turns the reference feature on or off

### Turning the Reference Feature On and Off

Select or clear the Reference check box.

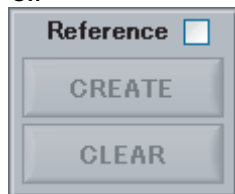
Off

- The CREATE and CLEAR buttons are dimmed.
- You can set up to 16 sub-channel source levels (see section 5.5 for details).

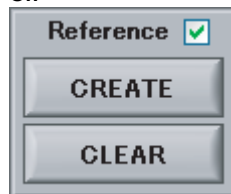
On

- The CREATE and CLEAR buttons are available.
- You can only set one sub-channel source level.

Off



On



### Creating a Reference Plot

Click **CREATE**. The measured data plot is registered as a reference plot.

You can register up to 15 reference plots.

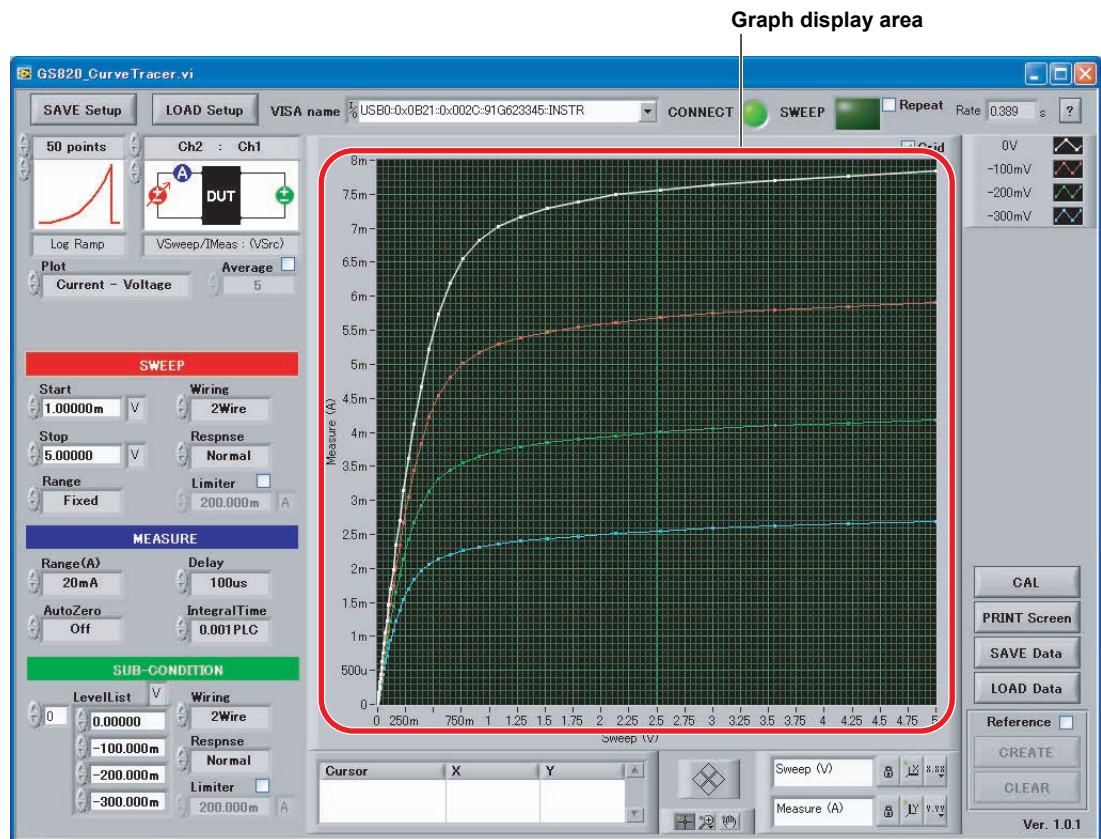
### Deleting Reference Plots

Click **CLEAR**. All reference plots are cleared.

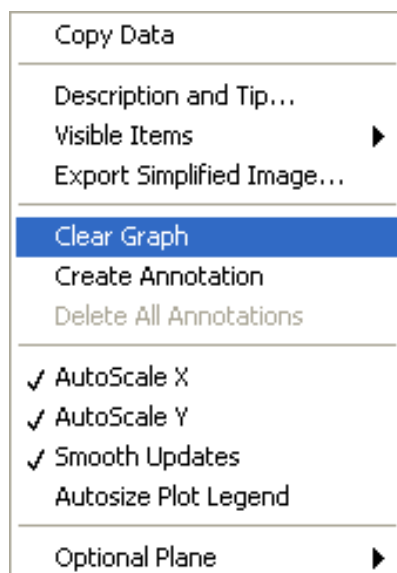
You cannot delete individual reference plots, but you can hide a reference plot by setting its color to T, for transparent (see section 7.2 for details).



## 7.9 Clearing the Graph Display



1. Right-click the graph display area.
2. Select **Clear Graph**.

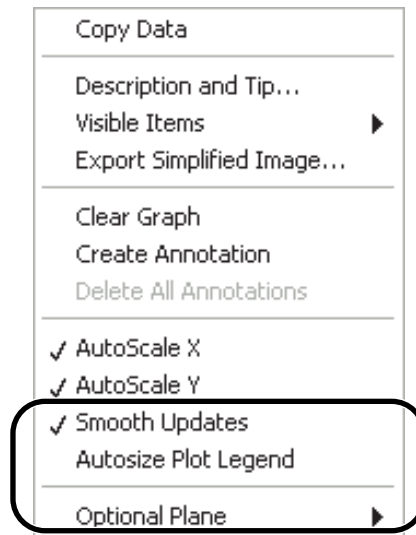




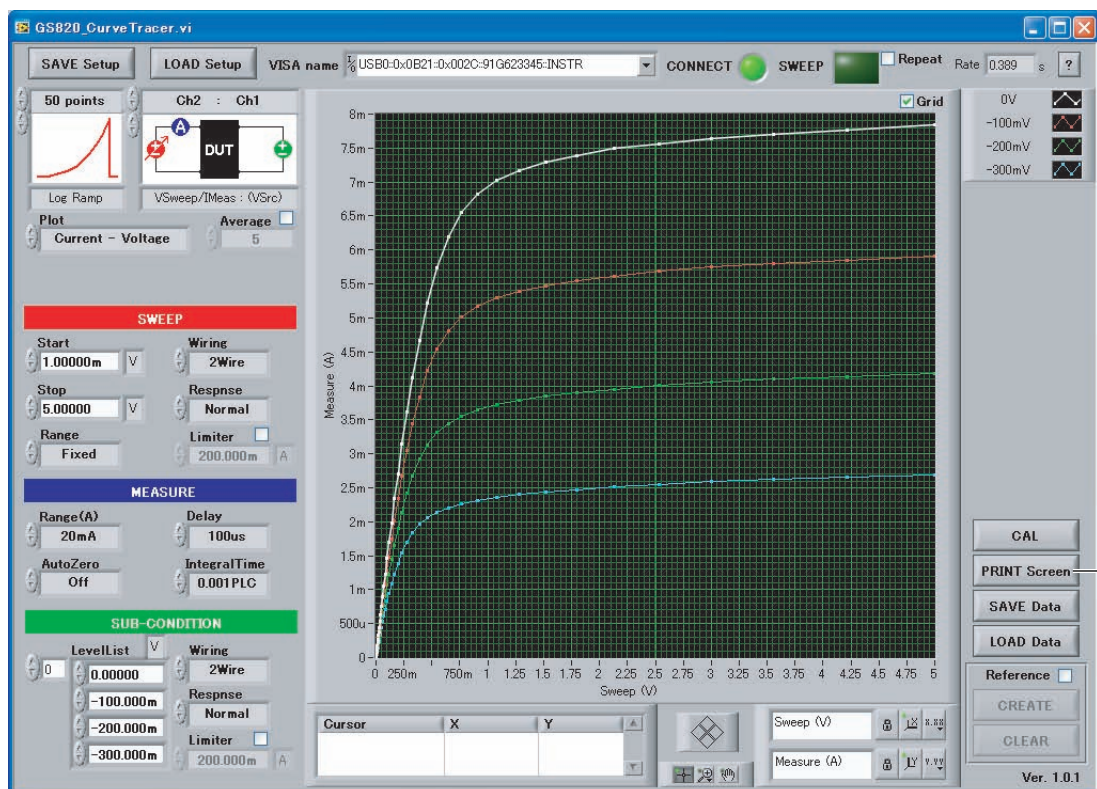
## 7.10 Other Menu Items

The following menu items in the menu that appears when you right-click the graph display area are not used in this software.

- Smooth Updates
- Autosize Plot Legend
- Optional Plane



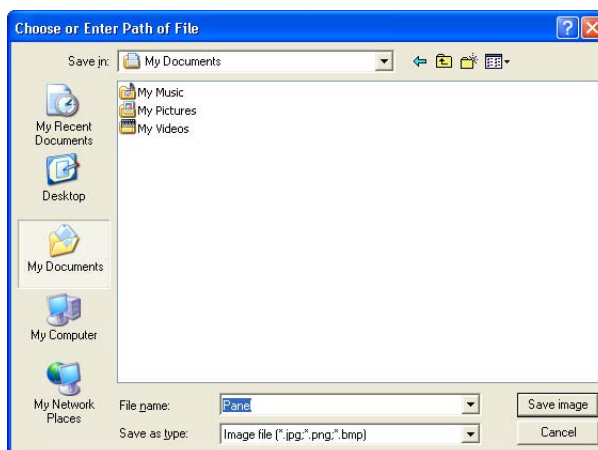
## 8.1 Saving Screen Captures



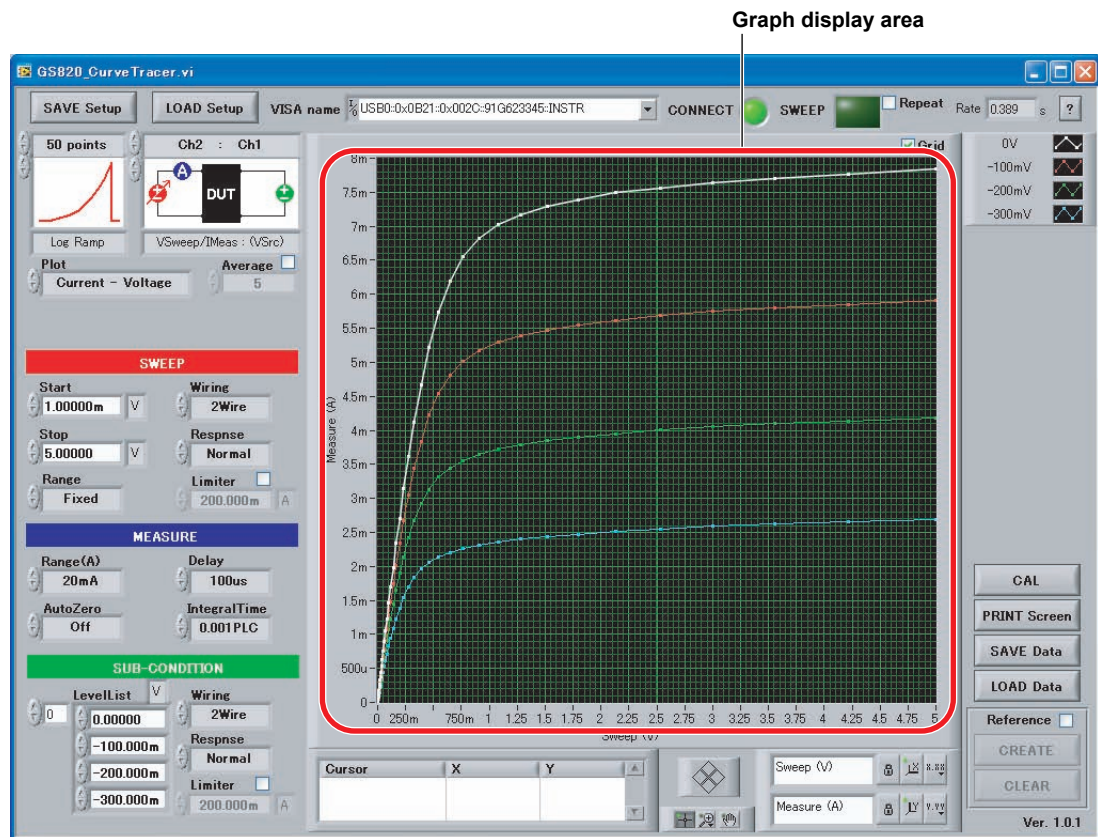
Saves a screen capture

This section explains how to save a screen capture to a JPEG, PNG, or BMP file.

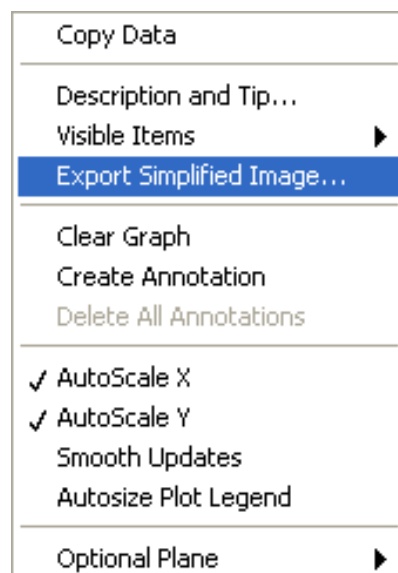
1. Click **PRINT Screen**.
2. Set the save location, the file name, and the file type.
  - The file is saved in JPEG format if you do not add an extension to the file name or if you add a .jpg extension.
  - The file is saved in PNG format if you add a .png extension to the file name.
  - The file is saved in BMP format if you add a .bmp extension to the file name.
3. Click **Save image**. The screen capture is saved.



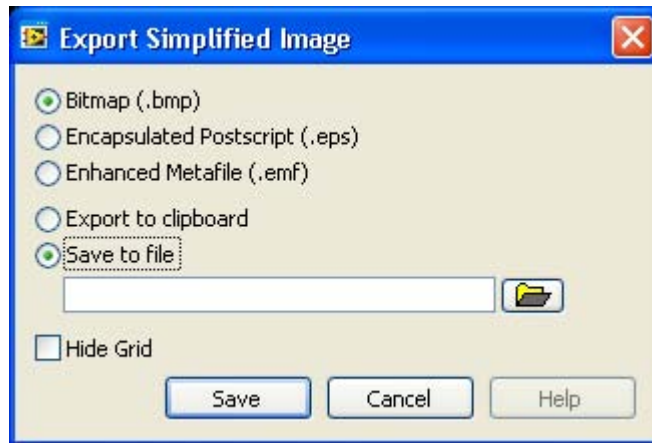
## 8.2 Saving or Exporting a Partial Screen Capture



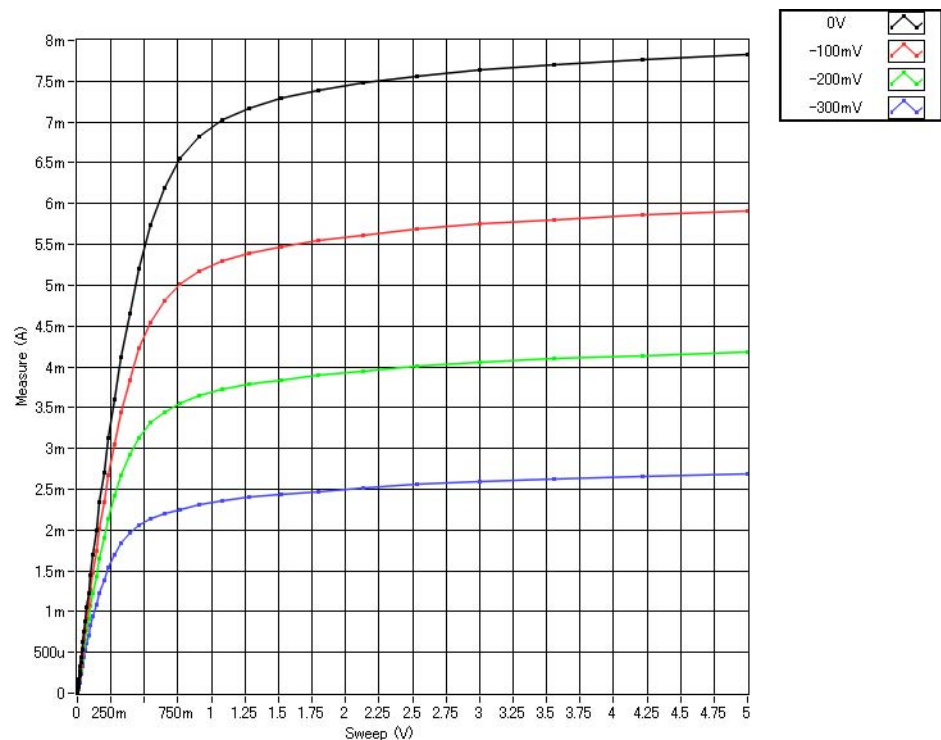
1. Right-click the graph display area.
2. Click **Export Simplified Image**.



3. Set the format of the exported image to BMP, EPS, or EMF.
4. Select where to export the image. If you select "Save to file," specify the file name and location.
5. Select or unselect the Hide Grid check box.
6. Click **Save**.



Example of a partial screen capture exported to a file



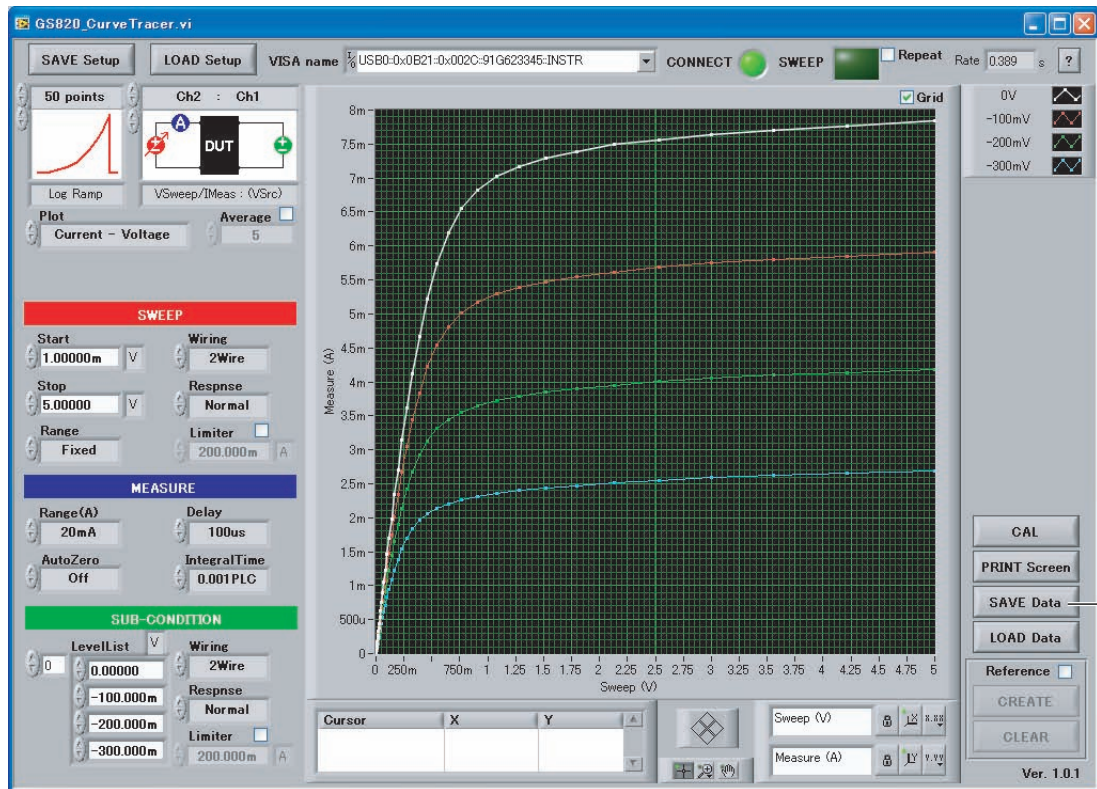
### Note

Exported partial screen captures only contain the graph display area and the plot legend. Items such as the setup data on the left of the PC display are not included. If you would like to acquire an image that includes these items, use the screen capture save feature (see section 8.1 for details).



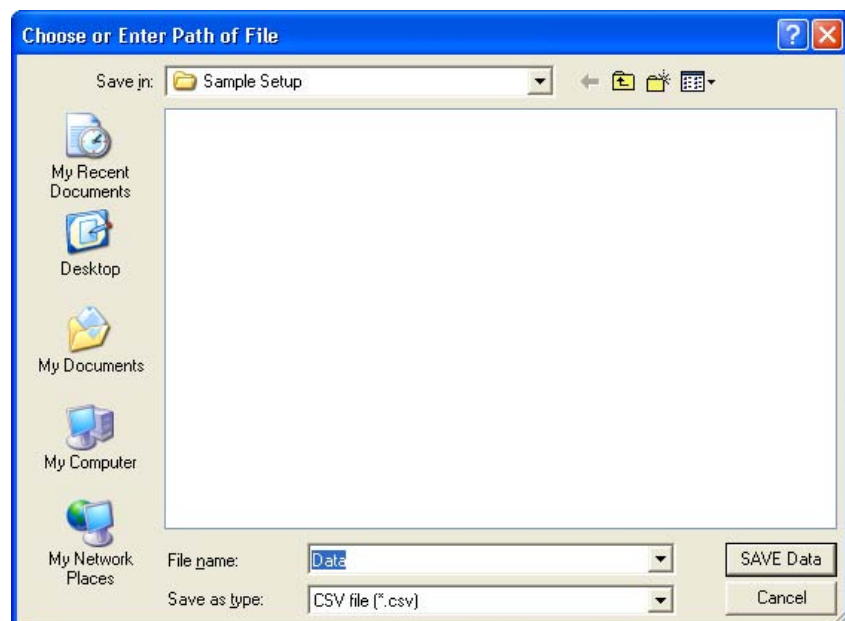
## 8.3 Saving Measured Data

This section explains how to save the displayed plots (measured data) to a CSV file. The data of displayed reference plots is also saved.



Saves measured data

1. Click **SAVE Data**.
2. Set the save location and the file name.
3. Click **Save Data** to save the displayed measured data.



The measured data is saved in the manner shown below.

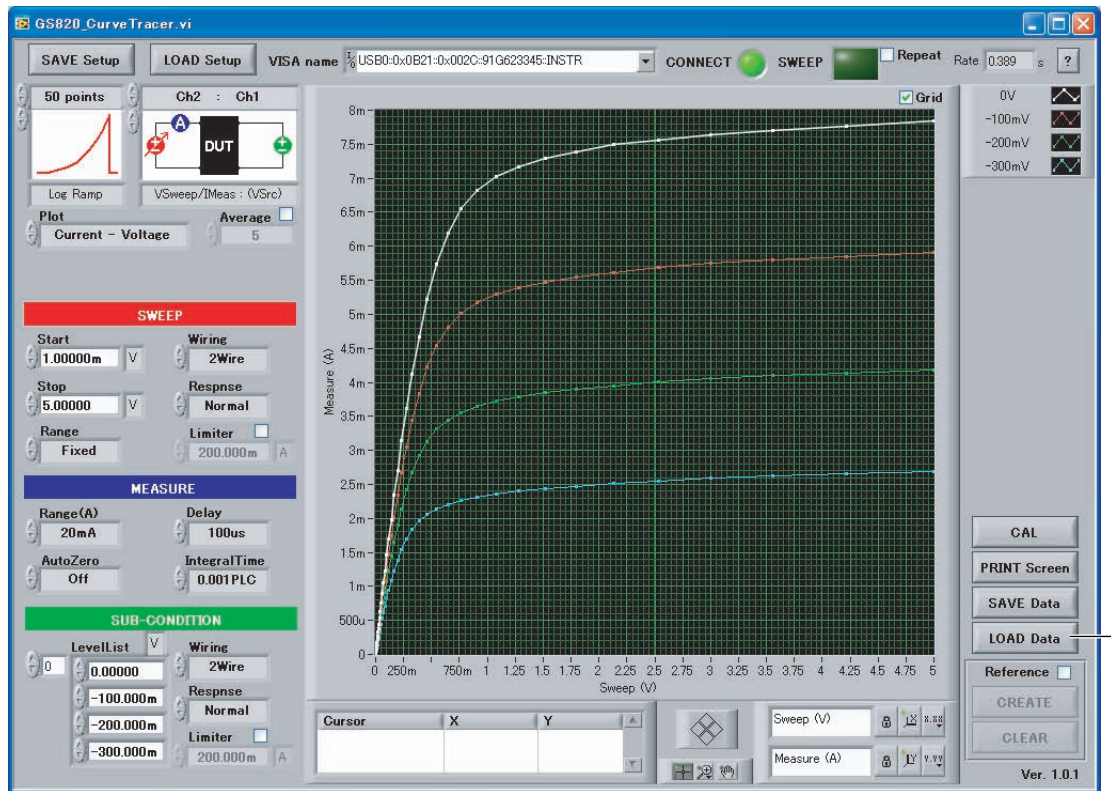
Example for when the graph display area contains four plots

Column headers: Scale labels and the plot legend label

	X-axis values of plot 0		Y-axis values of plot 0		X-axis values of plot 1		Y-axis values of plot 1		X-axis values of plot 2		Y-axis values of plot 2		X-axis values of plot 3		Y-axis values of plot 3	
	A	B	C	D	E	F	G	H	I							
1	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)	Sweep (V)	Measure (A)
2	1.00E-03	1.03E-05	1.00E-03	-2.74E-06	1.00E-03	1.03E-05	1.00E-03	1.03E-05	1.00E-03	1.03E-05	1.00E-03	1.03E-05	1.00E-03	1.03E-05	1.00E-03	1.03E-05
3	1.19E-03	1.03E-05	1.19E-03	1.03E-05	1.19E-03	1.03E-05	1.19E-03	1.03E-05	1.19E-03	1.03E-05	1.19E-03	1.03E-05	1.19E-03	1.03E-05	1.19E-03	1.03E-05
4	1.41E-03	1.03E-05	1.41E-03	1.03E-05	1.41E-03	1.03E-05	1.41E-03	1.03E-05	1.41E-03	1.03E-05	1.41E-03	1.03E-05	1.41E-03	1.03E-05	1.41E-03	1.03E-05
5	1.67E-03	1.03E-05	1.67E-03	1.03E-05	1.67E-03	1.03E-05	1.67E-03	1.03E-05	1.67E-03	1.03E-05	1.67E-03	1.03E-05	1.67E-03	1.03E-05	1.67E-03	1.03E-05
6	1.98E-03	1.03E-05	1.98E-03	2.33E-05	1.98E-03	1.03E-05	1.98E-03	1.03E-05	1.98E-03	1.03E-05	1.98E-03	1.03E-05	1.98E-03	1.03E-05	1.98E-03	1.03E-05
7	2.34E-03	2.33E-05	2.34E-03	2.33E-05	2.34E-03	2.33E-05	2.34E-03	2.33E-05	2.34E-03	2.33E-05	2.34E-03	2.33E-05	2.34E-03	2.33E-05	2.34E-03	2.33E-05
8	2.78E-03	2.33E-05	2.78E-03	2.33E-05	2.78E-03	2.33E-05	2.78E-03	2.33E-05	2.78E-03	2.33E-05	2.78E-03	2.33E-05	2.78E-03	2.33E-05	2.78E-03	2.33E-05
9	3.30E-03	3.63E-05	3.30E-03	2.33E-05	3.30E-03	2.33E-05	3.30E-03	2.33E-05	3.30E-03	2.33E-05	3.30E-03	2.33E-05	3.30E-03	2.33E-05	3.30E-03	2.33E-05
10	3.91E-03	4.93E-05	3.91E-03	3.63E-05	3.91E-03	3.63E-05	3.91E-03	3.63E-05	3.91E-03	3.63E-05	3.91E-03	3.63E-05	3.91E-03	3.63E-05	3.91E-03	3.63E-05
11	4.63E-03	6.23E-05	4.63E-03	4.93E-05	4.63E-03	4.93E-05	4.63E-03	4.93E-05	4.63E-03	4.93E-05	4.63E-03	4.93E-05	4.63E-03	4.93E-05	4.63E-03	4.93E-05
12	5.49E-03	7.53E-05	5.49E-03	6.23E-05	5.49E-03	6.23E-05	5.49E-03	6.23E-05	5.49E-03	6.23E-05	5.49E-03	6.23E-05	5.49E-03	6.23E-05	5.49E-03	6.23E-05
13	6.51E-03	7.53E-05	6.51E-03	7.53E-05	6.51E-03	7.53E-05	6.51E-03	7.53E-05	6.51E-03	7.53E-05	6.51E-03	7.53E-05	6.51E-03	7.53E-05	6.51E-03	7.53E-05
14	7.72E-03	1.14E-04	7.72E-03	8.83E-05	7.72E-03	7.53E-05	7.72E-03	7.53E-05	7.72E-03	7.53E-05	7.72E-03	7.53E-05	7.72E-03	7.53E-05	7.72E-03	7.53E-05
15	9.16E-03	1.27E-04	9.16E-03	1.14E-04	9.16E-03	1.01E-04	9.16E-03	1.01E-04	9.16E-03	1.01E-04	9.16E-03	1.01E-04	9.16E-03	1.01E-04	9.16E-03	1.01E-04
16	1.09E-02	1.53E-04	1.09E-02	1.27E-04	1.09E-02	1.14E-04	1.09E-02	1.14E-04	1.09E-02	1.14E-04	1.09E-02	1.14E-04	1.09E-02	1.14E-04	1.09E-02	1.14E-04
17	1.29E-02	1.79E-04	1.29E-02	1.66E-04	1.29E-02	1.40E-04	1.29E-02	1.40E-04	1.29E-02	1.40E-04	1.29E-02	1.40E-04	1.29E-02	1.40E-04	1.29E-02	1.40E-04
18	1.53E-02	2.18E-04	1.53E-02	1.92E-04	1.53E-02	1.66E-04	1.53E-02	1.66E-04	1.53E-02	1.66E-04	1.53E-02	1.66E-04	1.53E-02	1.66E-04	1.53E-02	1.66E-04
19	1.81E-02	2.71E-04	1.81E-02	2.31E-04	1.81E-02	2.05E-04	1.81E-02	2.05E-04	1.81E-02	2.05E-04	1.81E-02	2.05E-04	1.81E-02	2.05E-04	1.81E-02	2.05E-04
20	2.15E-02	3.23E-04	2.15E-02	2.84E-04	2.15E-02	2.31E-04	2.15E-02	2.31E-04	2.15E-02	2.31E-04	2.15E-02	2.31E-04	2.15E-02	2.31E-04	2.15E-02	2.31E-04
21	2.54E-02	3.75E-04	2.54E-02	3.36E-04	2.54E-02	2.84E-04	2.54E-02	2.84E-04	2.54E-02	2.84E-04	2.54E-02	2.84E-04	2.54E-02	2.84E-04	2.54E-02	2.84E-04
22	3.02E-02	4.40E-04	3.02E-02	3.88E-04	3.02E-02	3.36E-04	3.02E-02	3.36E-04	3.02E-02	3.36E-04	3.02E-02	3.36E-04	3.02E-02	3.36E-04	3.02E-02	3.36E-04
23	3.58E-02	5.31E-04	3.58E-02	4.79E-04	3.58E-02	3.88E-04	3.58E-02	3.88E-04	3.58E-02	3.88E-04	3.58E-02	3.88E-04	3.58E-02	3.88E-04	3.58E-02	3.88E-04
24	4.24E-02	6.35E-04	4.24E-02	5.57E-04	4.24E-02	4.79E-04	4.24E-02	4.79E-04	4.24E-02	4.79E-04	4.24E-02	4.79E-04	4.24E-02	4.79E-04	4.24E-02	4.79E-04
25	5.03E-02	7.52E-04	5.03E-02	6.61E-04	5.03E-02	5.70E-04	5.03E-02	5.70E-04	5.03E-02	5.70E-04	5.03E-02	5.70E-04	5.03E-02	5.70E-04	5.03E-02	5.70E-04
26	5.96E-02	8.82E-04	5.96E-02	7.78E-04	5.96E-02	6.48E-04	5.96E-02	6.48E-04	5.96E-02	6.48E-04	5.96E-02	6.48E-04	5.96E-02	6.48E-04	5.96E-02	6.48E-04

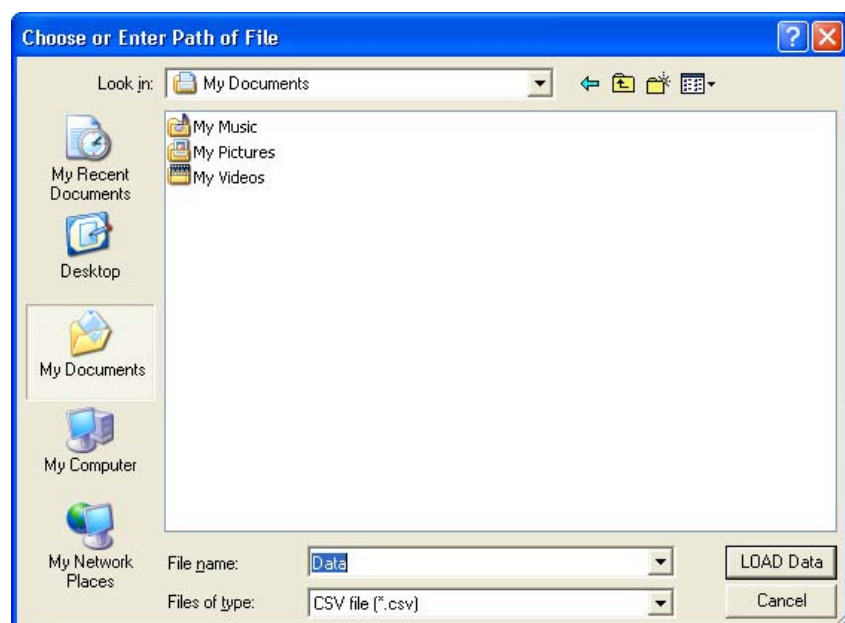
## 8.4 Loading Measured Data

This section explains how to load and display the plots (measured data) that you saved in section 8.3. If you load a file that contains reference plots, the reference plots are also displayed.



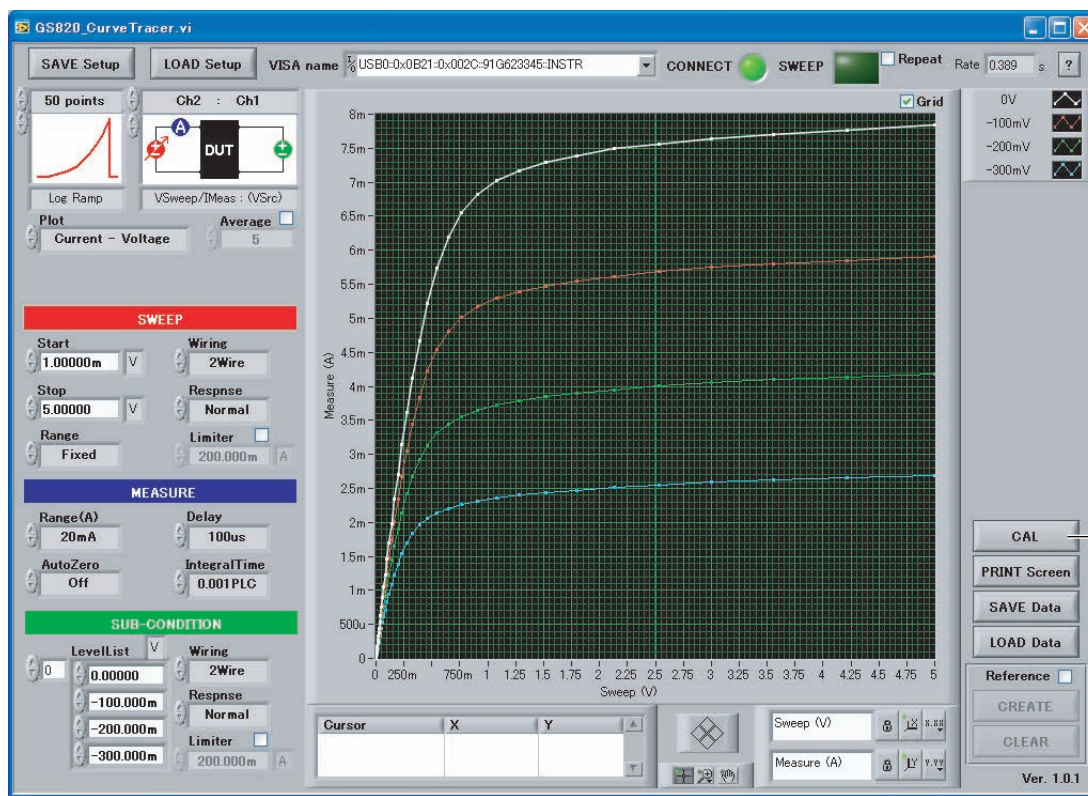
Loads measured data

1. Click **LOAD Data**.
2. Specify the location and the file name of the file that you want to load.
3. Click **Load Data**. The measured data is loaded and displayed as plots.





## 9.1 Executing Calibration



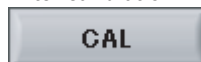
Executes calibration

Click **CAL** to correct for source offset and measurement offset caused by temperature changes and other factors. Calibration takes about 10 seconds. During calibration, the CAL button is displayed in dark gray. After calibration ends, the button returns to its normal color.

During calibration



After calibration

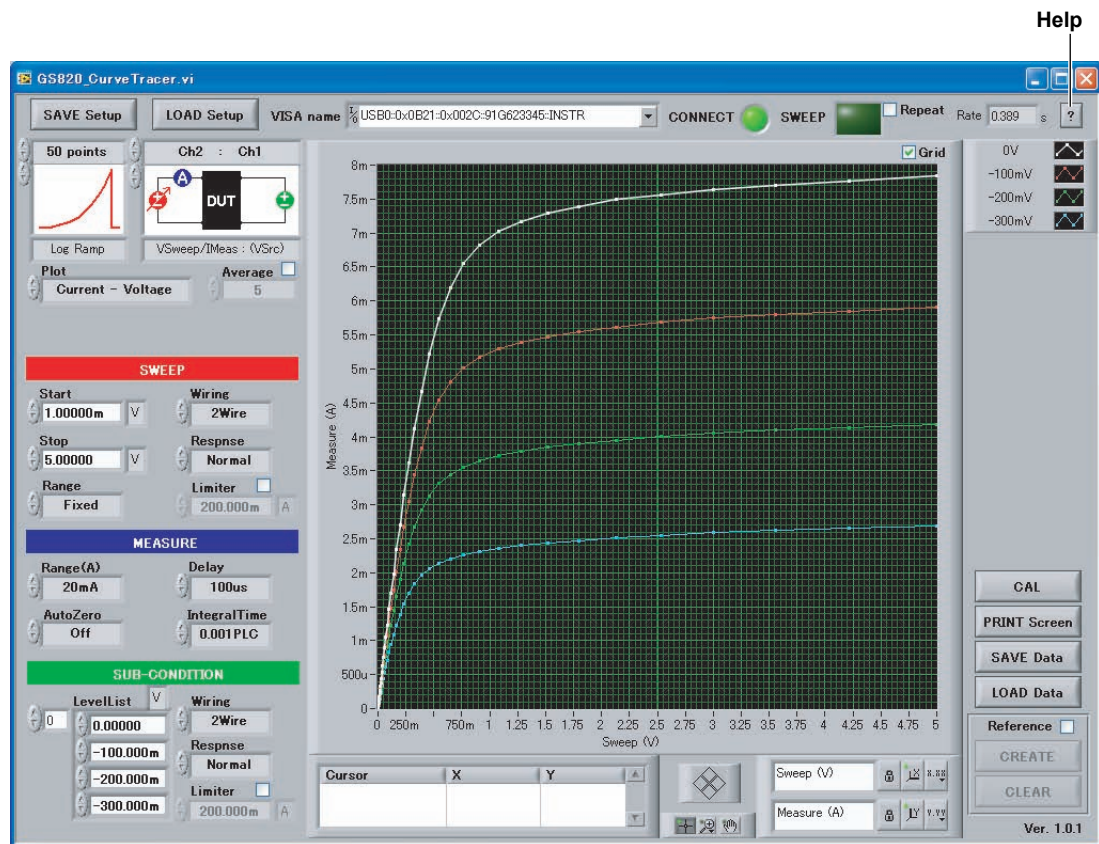


### Note

- If you execute calibration during a sweep operation, the sweep operation stops and the plot is not displayed.
- The effects of calibration are lost after you turn off the GS.

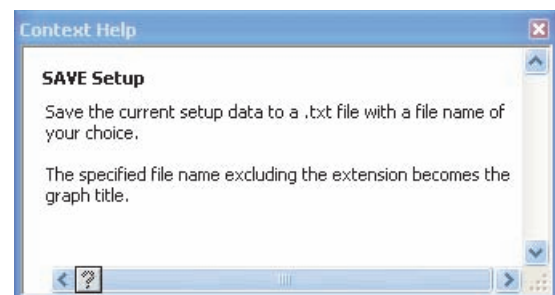


## 9.2 Using the Help Feature




### Displaying Help

1. Click the help button. A help window opens.
2. Point to the item that you want to know more about. An explanation of the item appears in the help window.

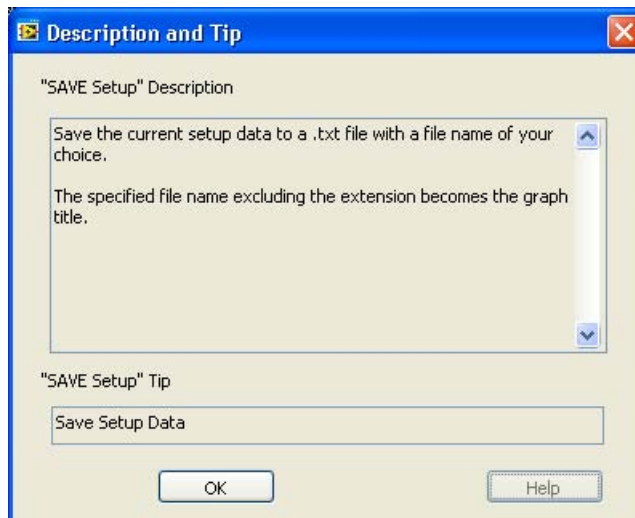
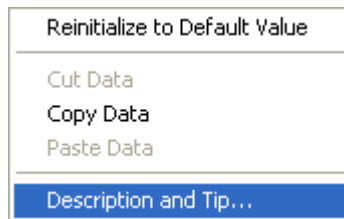


### Closing the Help Window

To close the help window, click  in the help window.

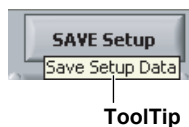
### Displaying an Explanation

Right-click on the item that you would like to know more about, and then click **Description and Tip**. An explanation of the item appears.



### Displaying a ToolTip

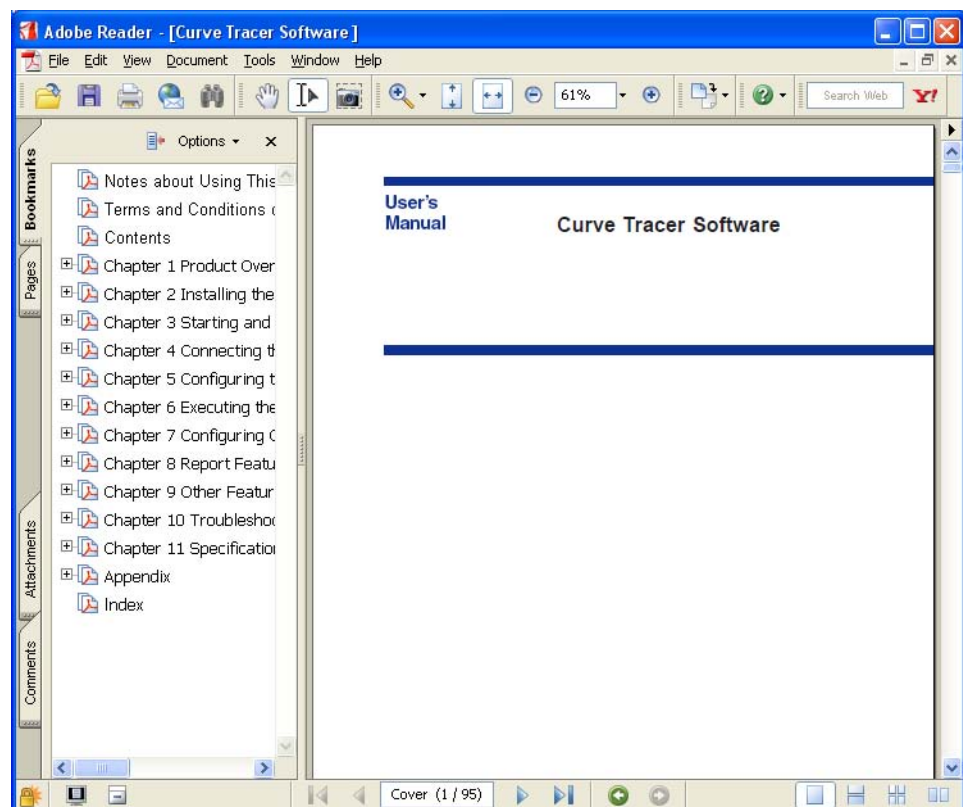
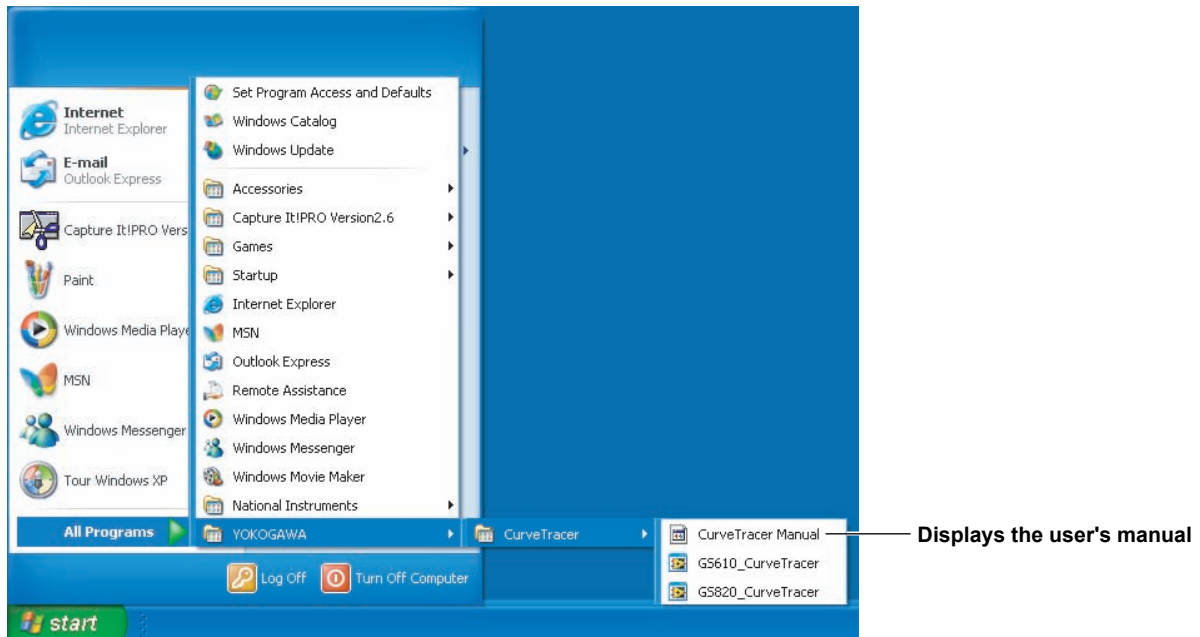
Point to the item that you want to know more about, and then leave the mouse pointer still for a few seconds. A brief description of the item appears.



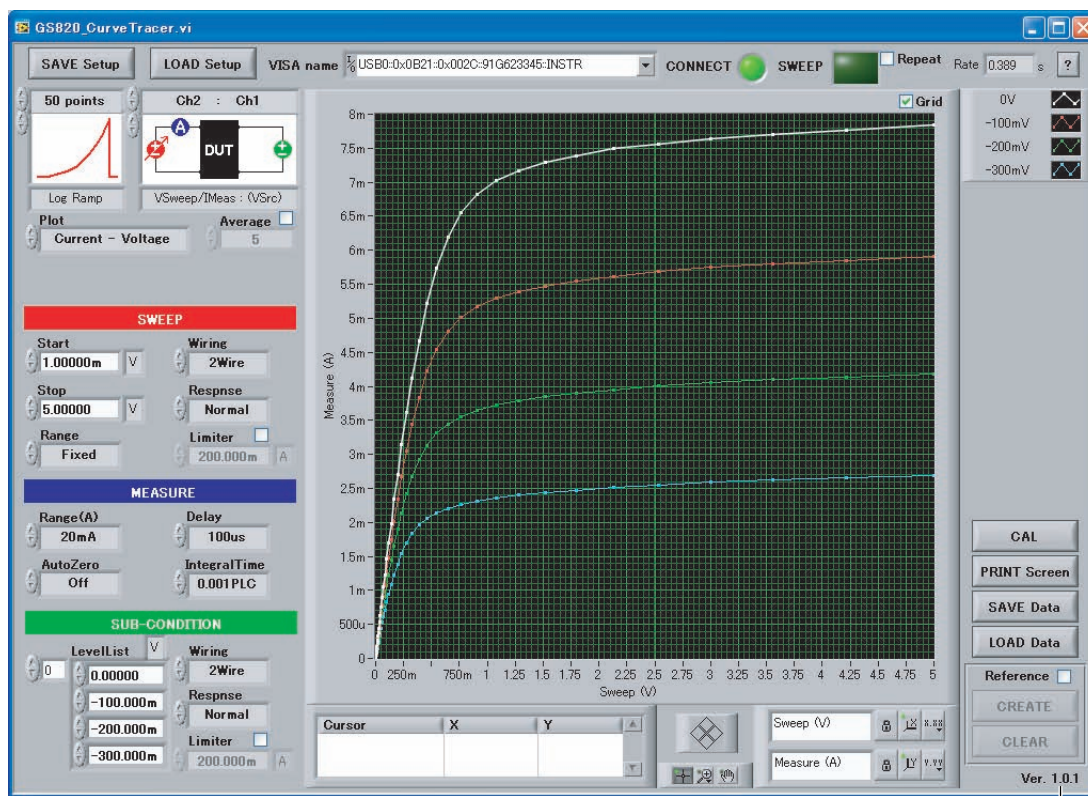
## 9.2 Using the Help Feature

### Displaying the User's Manual

On the taskbar, click Start, point to All Programs > Yokogawa > CurveTracer, and click CurveTracer Manual. If Adobe Reader is installed, it will start and open the PDF User's Manual for this software.



## 9.3 Viewing the Software Version



Version

The software version is displayed at the bottom right of the window.

# 10.1 Troubleshooting

Problem	Likely Causes/Solutions
Cannot connect to the GS.	<ul style="list-style-type: none"> <li>The communication interface cable may not be properly connected. Connect the cable properly.</li> <li>Check that the VISA library is installed properly and that the VISA name is correct.</li> <li>The GP-IB address setting may be incorrect.</li> <li>The RS-232 interface setting may be incorrect.</li> <li>The Ethernet network settings may be incorrect.</li> <li>The USB interface mode may be set to storage.</li> </ul>
Plots are not displayed. Plots do not fit in the graph display area.	<ul style="list-style-type: none"> <li>The measurement range may be too small for the measured signal. Increase the measurement range.</li> <li>The scale settings may be incorrect. Turn on the auto scale feature, or check the manual scale settings.</li> <li>The CSV setting may be incorrect. Check that the CSV setting matches the settings of the PC. (See section 2.3 for details.)</li> </ul>
The plot is staircase shaped.	The measurement range may be too wide for the measured signal. Decrease the measurement range.
The plot is affected by power-line noise.	Set the integration time to 1 PLC or higher.
Cannot set Range to Auto.	If the GS820 firmware is earlier than version 1.04, the Auto option is dimmed and unavailable. Update the GS820 firmware to version 1.04 or later.
Some menu items do not function.	This software was created using National Instruments LabVIEW. Some menu items appear that are standard for LabVIEW graph display tools and parts, but that are not used in this software. These items do not function even when the software is working properly.

## Note

For the latest information about this software, see the Webpage below:  
[www.yokogawa.com/tm/gmi/765670/tm-765670\\_01.htm](http://www.yokogawa.com/tm/gmi/765670/tm-765670_01.htm)

## 11.1 Specifications

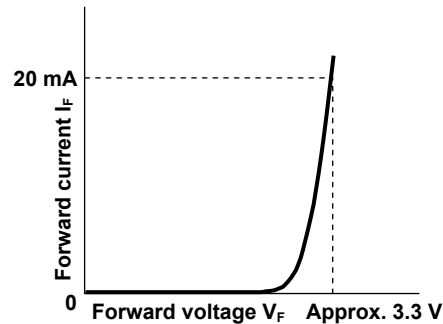
Item	Specifications
Graph Plotting	Voltage-current, voltage-voltage, gain-voltage, voltage-timestamp, current-voltage, current-current, gain-current, and current-timestamp <ul style="list-style-type: none"><li>• Sweep axis Voltage source or current source</li><li>• Measurement axis Voltage measurement or current measurement</li><li>• Parameter Voltage source or current source</li><li>• Sweep forms Ramp (linear or logarithmic), triangular (linear or logarithmic), or rectangular</li><li>• Sweep points 5, 10, 20, 50, 100, 200, or 1000</li><li>• Scaling Auto scale or fixed scale</li><li>• Averaging Can average 2 to 100 values</li></ul>
Analytical features	Cursors, zooming and scrolling, and reference plot configuration
File operations	CSV data saving and loading, graph image saving, panel image saving, and setup data saving and loading

# Appendix

## Example: Plotting the Characteristic Curve of an LED

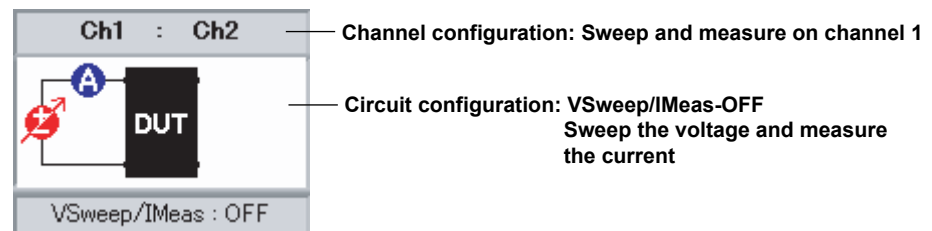
This section explains the implications of each sweep setting by using the plotting of an LED forward voltage-current characteristic curve as an example.

This example assumes that we know from catalog specifications or some other source that the LED has a characteristic curve approximately equivalent to the one shown below. (Both the X and Y axes are linear). However, the upper limit of current  $I_F$  is 20 mA.



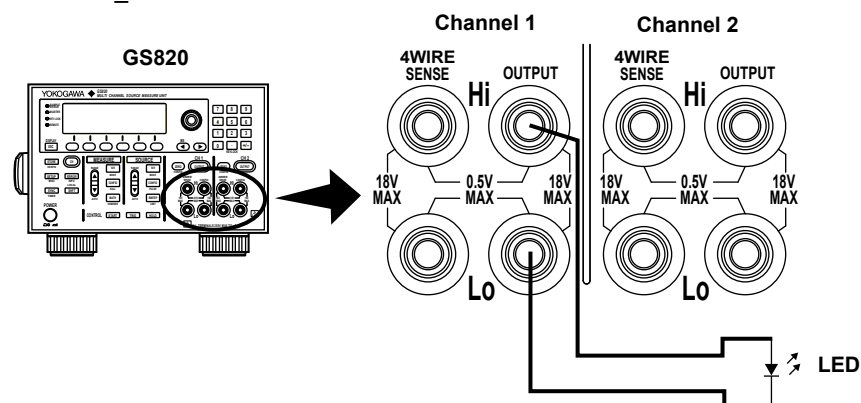
To evaluate this characteristic curve, use the GS610 or channel 1 of the GS820, and configure the GS to sweep the voltage and measure the current.

Configure the Curve Tracer Software's channel settings and circuit configuration as shown in the figure below:



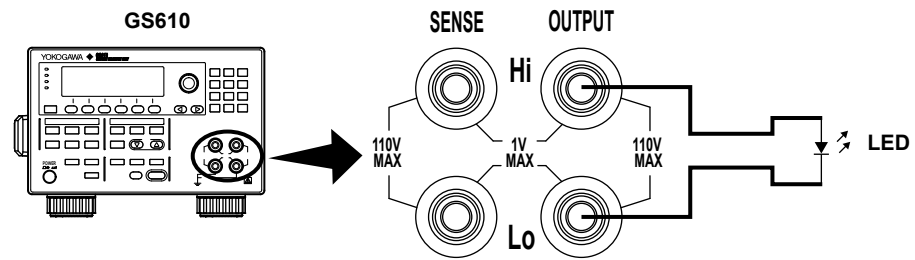
Connect the GS to the LED under measurement as shown in the figure below:

In GS820\_CurveTracer





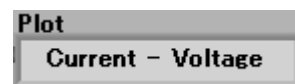
In GS610\_CurveTracer



The following is a description of each setting.

### Plot (Plotted items)

The objective is to plot a graph whose Y-axis represents current and whose X-axis represents voltage, so set the Plot box as shown below.



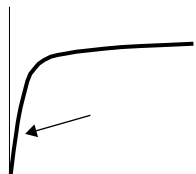
### Sweep Form and Sweep Points

In this example, the X-axis (the axis that is swept) of the graph is linear, so set a linear sweep form.

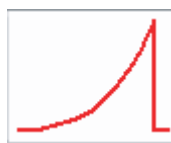
#### Linear sweep



Depending on the shape of the graph, even when the axis is linear, there are times when using a logarithmic sweep form allows you to plot a graph whose individual points are not too far apart. A logarithmic sweep form is advantageous in cases such as the example below, where the graph changes suddenly within a small portion of the sweep axis.



#### Log sweep



The more sweep points there are, the longer measurement takes. Try to find the right balance between plot detail (resolution) and measurement speed.



### Sweep Settings

Because you want to measure up to the point where the current reaches 20 mA, the voltage sweep range should be approximately 0 to 3.3 V. The current  $I_F$  cannot exceed 20 mA, so use the limiter feature to set the upper limit of the current to 20 mA. Set the upper limit of the voltage sweep range (for  $V_F$ ) to 3.5 V, a value at which the current is certain to reach 20 mA.

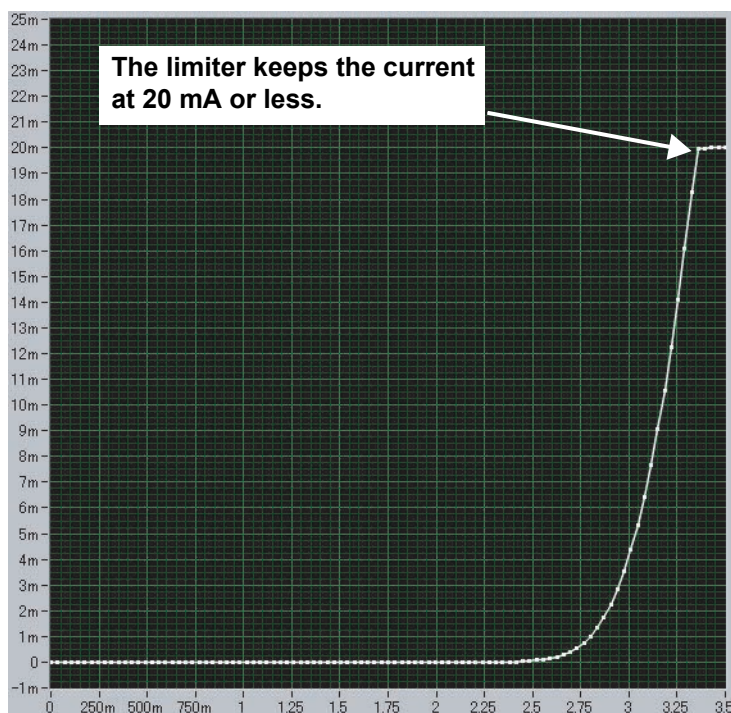
Sweep range of voltage  $V_F$



Current limiter set to 20 mA



Executing the sweep operation using these settings will result in the following graph.



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